Telephony.

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Important Improvements in Large Telephone Switchboard Systems.

The telephone exchange which has been re-equipped recently at Bloomington, Ills., presents many points of interest, as it represents the great progress which is being made in Independent telephony, in the question of increasing to accommodate all demands for service, as well as building for a permanent investment, and shows one of the first switchboard equipment installations in which a system may be changed from a trunking into a multiple, and one in which a plant may be re-equipped in part at intervals, without in any way interferring with the service and without any great extra expense above the cost of the complete system when installed at one time.

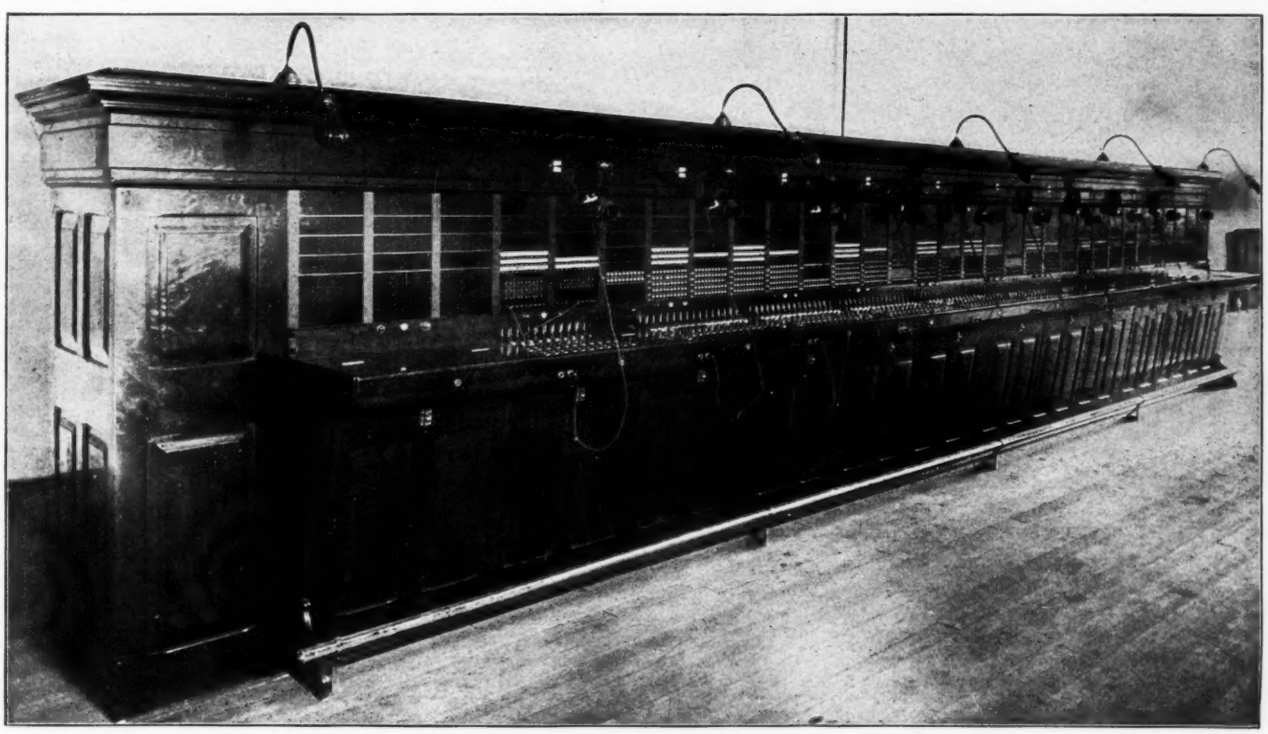


FIG. I. MAIN SWITCHBOARD—HOME TELEPHONE COMPANY.

The exchange started in 1895 with about one hundred subscribers. It was built with common return lines and equipped with individual generator-call local battery telephones and a ring-down drop, straight trunking switchboard. The plant was built upon a basis of about five hundred lines ultimate capacity, which was deemed sufficient for all time to come. The number of subscribers, however, rapidly increased, necessitating adding new lines on the poles and enlarging the switchboard, section after section.

About a year ago when the exchange had reached nearly 800 subscribers and the number constantly increasing, it was found necessary to rebuild the plant in order to properly accommodate the increased demand. To provide means for the future increase, as well as rebuilding the system upon a thoroughly modern and durable basis, the company was re-organized with an increased capital.

The new company was headed by Mr. A. B. Cotton as president and Mr. Hart F. Farwell as secretary and treasurer, both of whom have been in the Independent telephone business from its incipiency in the manufacturing and operating lines, and are well known in the field.

The exchange was rebuilt by the Equitable Construction Company of Chicago. The lines in the down-town district were placed underground; a large amount of cable was

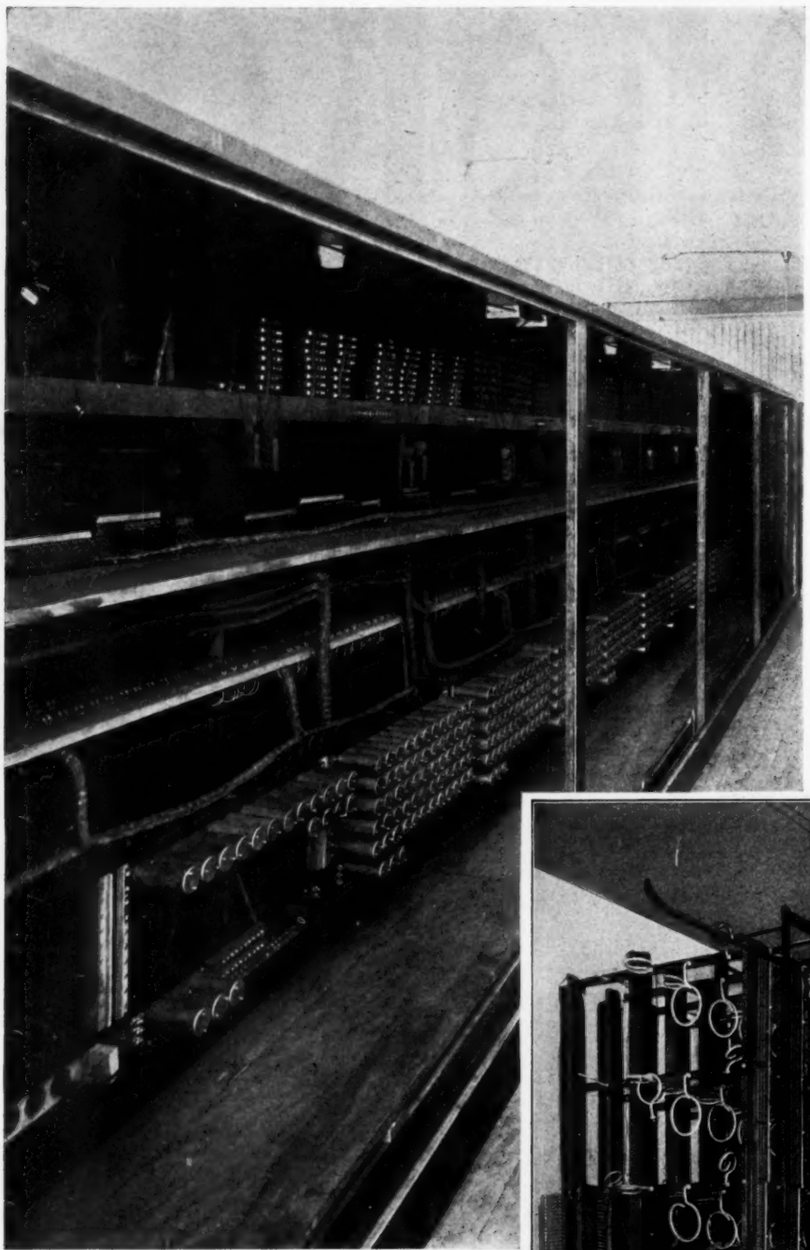


FIG. 2. REAR OF SWITCHBOARD—HOME TELEPHONE COMPANY.

used for the heavy aerial leads. The circuits were made full metallic.

On the question of equipment it was decided to install the system recently evolved by the International Telephone Manufacturing Company of Chicago, which allowed putting in a full central energy lamp signal strictly two-wire circuit multiple switchboard and instruments at intervals, as rapidly as possible.

The exchange was equipped at once with the board provided with a trunking system and a complete power plant for strictly central energy work. The old telephones were refitted to work on the system by cutting in a condenser, which was placed in the battery box. The old instrument was wired so it would signal the central office when taking the receiver from the hook and so the transmitter batteries remained locally at each instrument. For the increase in the exchange strictly central energy instruments were used.

The system is so arranged that it is possible to make the change without interrupting the service of the exchange. The old remodeled telephones were replaced gradually with full central energy instruments. Figure 1 shows the main switchboard. The present equipment consists of four sections of three operators' positions each, with a multiple capacity in each section for multiplying the 2,400 lines. The switchboard, as originally installed, is arranged with a trunking system between the operators' positions.

The lamp line signals and answering jacks are placed at the bottom of the face of the board. The trunking jacks and order keys are placed in each position, immediately above the line signals. The board is so designed and fully wired for changing the system into a strictly multiple system, by adding the necessary multiple jacks with wiring, etc., in each section and making the proper connection before cutting over the system.

To make the change, the multiple jacks are temporarily placed above the trunking equipment and when they have been properly wired and connected and the system

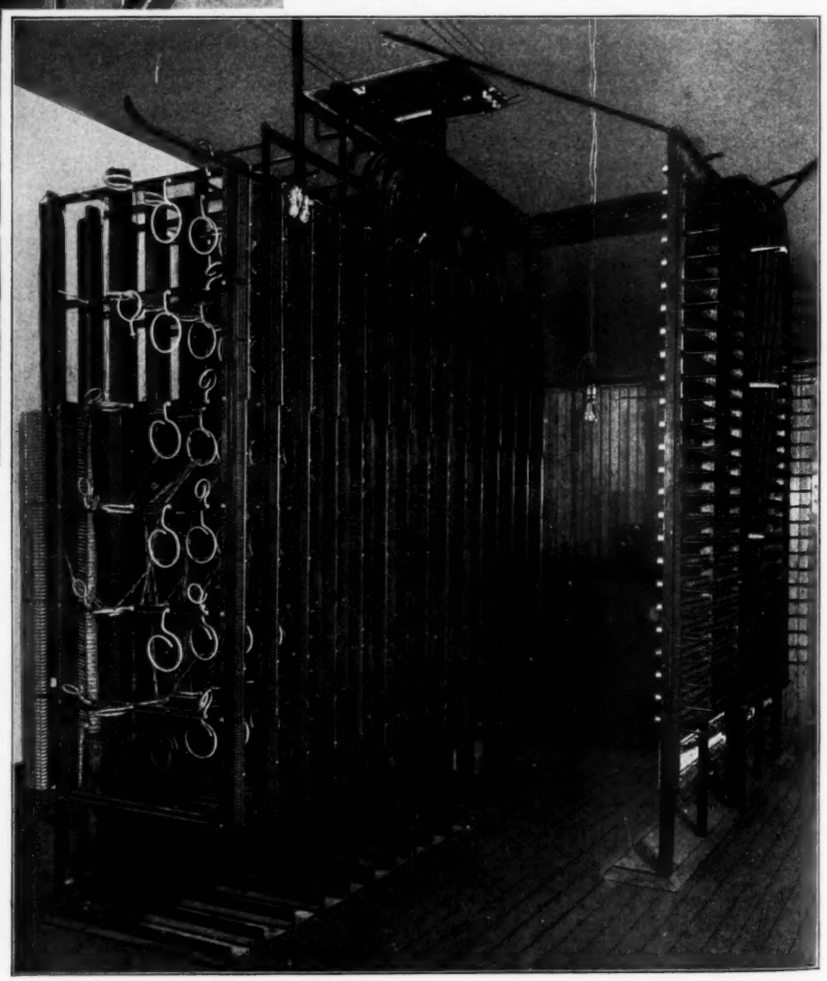


FIG. 3. RELAY RACK AND COMBINATION INTERMEDIATE DISTRIBUTING BOARD.

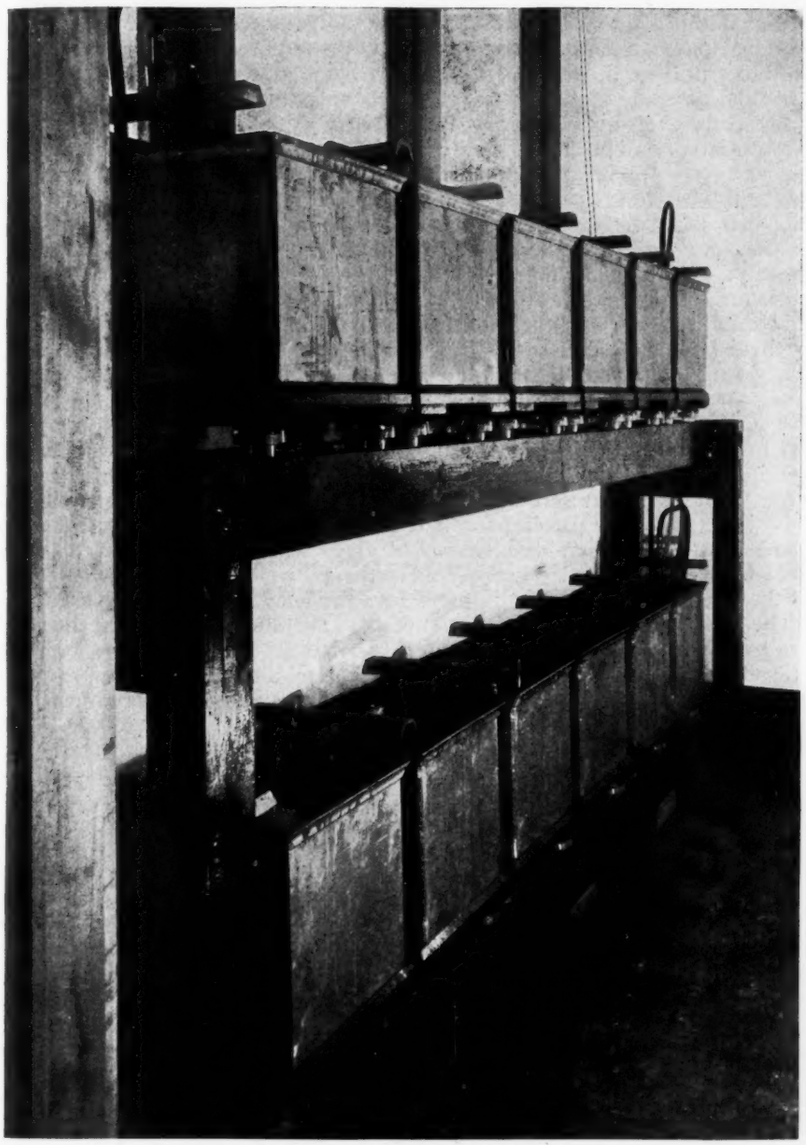


FIG. 5. BATTERY PLANT.

cut over, they are lowered into proper position, after the trunking equipment has been removed. This change can be made without any interference with the service.

The first equipped position is provided with 25 in-coming trunk or toll lines. Part of the lines are used for trunks direct to the branch exchange at Normal, Illinois, and part are used as trunks to the toll line company's switchboard. The toll line position is also equipped with a complete operator's instrument, necessary connecting appliances for connecting between the toll lines and the branch exchange lines and between the local exchange with both toll lines and branch exchange lines.

Each operator's position of exchange subscribers' lines is equipped with 120 lamp line signals with answering jacks, proper trunking equipment for connecting with other positions and complete operator's telephone, fifteen pairs of connecting appliances with double lamp supervisory clearing-out signals, ringing and listening keys, together with selective ringing party line keys.

Each position is also equipped with a pilot lamp with the line signals and a pilot lamp with the supervisory signals and one with the ringing generator. Each position is equipped with two special jacks for connecting the operator's receiver.

The answering jacks are constructed in strips of ten. The front piece of the strip is made up of a veneer of a front and back piece of hard rubber, with the center piece

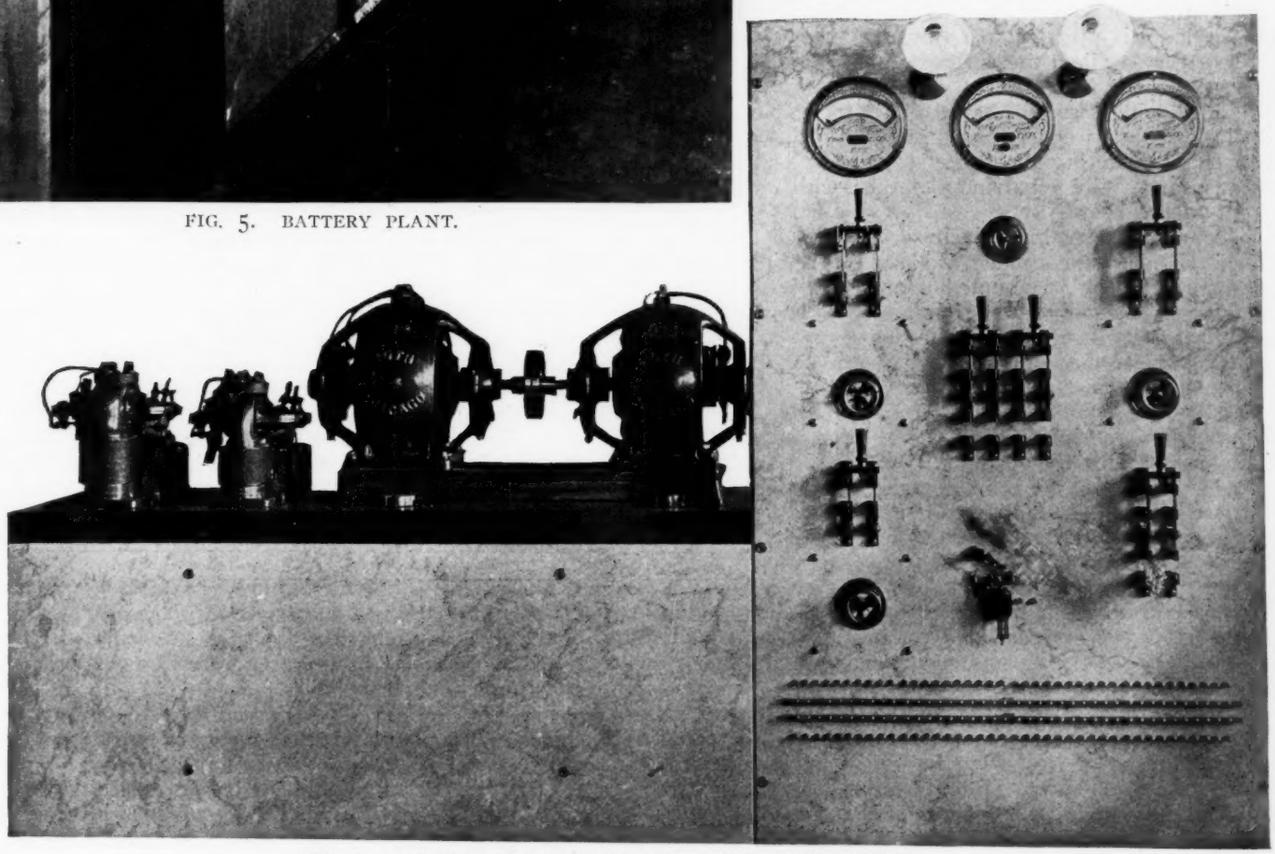


FIG. 4. POWER SWITCHBOARD AND POWER GENERATOR.

of a stiff brass rail. This brass rail is shouldered at both ends and provides a means for securely fastening the strips of jacks to the iron of the switchboard frame. The holes in the brass rail through which the jack ferules pass are of sufficient size to receive a hard rubber bushing between the ferules and rail to properly insulate them. The ferules are shouldered against the front rubber strip and are screwed into the bottom spring of the jack, firmly clamping the three parts of the front piece. This construction gives a jack in which the ferules can be readily removed and replaced from the front of the board without taking out the bank.

The bottom spring of the jack has part of its stock forced up to form a spring so the plug does not depend on the ferule of the jack for a connection, but is firmly held between two springs.

The back strip of the bank of jacks consists of a hard rubber piece, properly grooved to receive the jack springs. The springs are shouldered and are firmly clamped into the grooves by a heavy brass strip, insulated with mica. This construction gives a bank of jacks very light in weight, perfectly stiff and very durable.

The line signals are mounted in strips of ten and correspond with the answering jacks. The front piece of the bank is made up of a thin strip of hard rubber for the outer side and a heavy brass rail for the inner side. The brass rail is shouldered at both ends, the same as the rail of the bank of jacks. The holes for the lamps are of sufficient size to receive the lamp socket, but leave ample room on the side of the strip to make the bank strong and rigid. The jack springs have part of the stock forced up at the front end, giving a projection to make practically a point connection with the base of the lamp. The springs are shouldered into a grooved or slotted rubber back piece and are firmly clamped with a heavy brass strip, holding them perfectly secure and tight. The back piece with the springs is securely fastened to the front piece or brass rail with heavy brass studs or posts. This makes a very simple, compact and very rigid bank of lamp jacks.

The lamp is placed into an opaque tube which is slotted at the rear to allow the springs to enter and make contact with the base of the lamps. The front end of the tube is provided with a special brass cap, into which is fitted the opal. The brass cap is constructed with a small flange to prevent its entering the socket too far and also provide a means for readily removing the tube with lamp from the front of the board.

The supervisory lamp jacks are mounted individually. The springs are the same as are used on the line signal jack. The spring block is mounted upon a neatly designed base which can be readily fastened to any style board. The lamp tube is similar in design to the line signal tube, excepting that the opal cap or holder is made with a larger flange and is provided with an arched wire guard. This guard protects the opal from impact of the plugs and also serves as a handle for conveniently extracting the lamp. The pilot lamps are set into the opaque tube which, for this purpose, is provided with a large brass cup-shaped cap, into which the large colored glass bull's-eye is set. The pilot lamp jack is the same as the supervisory signal jack. The tube, with bull's-eye and lamp, is inserted from the front of the board.

The ringing and listening keys are mounted on a key board built up from five layers of hard wood. This key is a very neatly designed and compactly built cam. It has its two sets of springs mounted one above the other, which enables using long springs, and still with a comparatively short key. The springs are shouldered in a slotted rubber block and are securely clamped to a heavy brass base with a heavy brass plate and a binding screw passing through the plate and rubber spring block, into the heavy brass base.

The brass binding plate is insulated from the springs with heavy sheet mica. Both the ringing set and the listening set of springs being mounted one set above the other, and the springs in one block, brings all the terminals of the key to one end. To wire these keys it requires but one key cable or form, which is soldered from the rear and leaves the springs and platinum contact points open and free for inspection and testing when desired.

The cam lever is forked and one prong passes through the top set and spreads the bottom set from the rear. The other fork is shorter and reaches the top set of springs, which it spreads from the front. The springs all being very long, allow using heavy German silver spring, making them very live and lasting. It also allows having an exceptionally large lever ball or spreader, which gives a large space for making and breaking the connection and making it positive at all times.

The plug is very compactly built, but of sufficient size to have all distinct parts of sufficient strength to make them durable. They are made to fit jacks with three-eighth-inch centers for large multiple boards. The plug shell is mounted loosely on the shank and is held in position by a small collar or nut screwed on from the front. This avoids having a screw passing through the shell, which often is the cause of considerable breakage of plugs when used. The shell being mounted loosely, leaves the plug free to turn when it is twisted when inserted into the board, thus leaving the cord perfectly free from kinks and avoiding the principal cause of breaking the tinsel.

The plug board and also the pilot lamp panel are provided with belt leather of the same color as the switchboard cabinet work.

Fig. 2 shows the rear of the switchboard. The framework is made of heavy architectural iron, well braced to make it strong and rigid. The frames are built in sections for three positions each, with eight panels to the section. The sections are joined so that when completed they have the appearance of one continuous frame or board.

At the bottom of the frame is mounted a rack for the supervisory and operator's set relays. These relays are mounted so that when the shell is removed all parts may be conveniently inspected and tested. The relays are mounted individually in banks upon iron strips. They are so constructed that they may be readily removed and replaced.

All the equipment and wiring of the switchboard, excepting the trunking circuit, is complete for a full multiple switchboard, so that it will be necessary only to add the multiple wiring, etc., when changing into a multiple board.

Fig. 3 shows the relay rack and combination main and intermediate distributing board with lightning arresters, all completely wired. The relay rack is constructed of heavy angle iron and channel iron, well joined to make it strong and rigid. It is built in sections for the accommodation of the relays for 500 lines of multiple board each.

At the bottom of the relay rack is mounted a heavy marble slab with bus bars and fuses for the protection of the relays. The relays are so mounted that all parts may be readily and conveniently inspected or tested at any time. The distributing rack is arranged for main and intermediate distribution.

The lightning arresters used are the latest Rolfe patent self-soldering heat coil protectors, with carbon arresters, manufactured by the American Electric Fuse Company of Chicago.

The outside cables are run under a false floor, back to the distributing rack and terminate in pot-heads at the bottom of the lightning arresters. All inside wiring of the switchboard is of cables or wire with No. 22 conductor double silk and single cotton insulation.

Fig. 4 shows the power switchboard and power machines. The power board is made of heavy double marble slab, on which, at the top, are mounted Weston ammeters for the charging circuit and the discharging circuit, Weston voltmeter and volt-meter switch. The proper knife switches for controlling the system are of the best make C. & H. copper blade switches and are neatly mounted and properly con-

nected. The starting box and rheostat for the machines are mounted on a power board, as are also the necessary bus bars, with fuses for the operator's circuit.

At the top of the board are mounted two electric light brackets, with lamps, to properly light up the board.

The charging machines and ringing generators are of the Roth type and are mounted upon a strongly constructed table, provided with a hardwood top, supported by soft rubber balls to take up all vibration of the machines when running. The machines are run from a direct current circuit.

The front of the power table is covered with a heavy marble slab, the same as the power board.

Fig. 5 shows the battery plant, which consists of twelve cells metal tank chloride accumulator storage batteries. These batteries are mounted upon a heavy wooden rack. The batteries are placed in a separate room, which is well ventilated.

This complete equipment, including the installation of the 2,400-line capacity, 1,000-line equipped switchboard with toll position, the 1,500-line lightning arrester and cross-connecting rack with relay, power equipment and battery plant, was fully installed by the International company and placed, ready for operation, in three weeks from the time the goods were delivered and the installation started.

This is one of the quickest installations ever made of a plant of this size in the telephone field, and the system, which is now well demonstrated in actual exchange operation to be thoroughly practicable in every particular, is one of the best made and most modern and durable now in use.

Independent Telephone Systems.*

By J. J. NATE.

It is a comparatively easy matter for the Bell company to select those isolated Independent telephone plants which, from various causes, may have eventually failed, or whose purchase by that company removed competition from the field. Independent investments, which, from any cause whatsoever, have proven failures, are those which the Bell company hold up as danger signals, and as warnings to the investor in properties of this character. Men of observation and business acumen, notwithstanding these storm signals, are the men who have invested their money in the Independent cause, and the threats with a view to retarding the Independent telephone movement are without weight. It is true that many of the early beginners in the Independent telephone field were financial adventurers—men without means—men who thought they saw a grand opportunity on the "get-rich-quick" plan, and who, following out that theory, organized companies, interested local capital in their schemes, taking to themselves a lion's share of the profits in the capitalization of the stock, and then building so far beyond the actual earning capacity of the plant that the local stockholders who became the eventual purchasers were left to do the best they could with a property much over-capitalized, stock all subscribed and no money in the treasury. But note the result: The Independent telephone business grew so rapidly, and the profits were so satisfactory that many of these early promoters who had expected to drop out, having realized a substantial profit as a result of their first efforts, found it desirable to remain in the field, and the work afterwards performed by these same promoters has been carried on along legitimate lines. The exceptions to the rule are noticed in connection with a few of the plants, such as Detroit, New Orleans, Portland, San Jose, Eau Claire, Baltimore and Sioux City, which, as a result of financial scheming, failed to reach fruition in the Independent field.

The policy pursued by the Bell company in fighting the Independent movement has been practically the same all over the United States, and with a very few exceptions has signally failed in its intent. With the rapid advance of the work of the Independents, conservative capitalists and men of affairs, brokers and financiers, came to realize that there was in the Independent telephone field a legitimate opening for the investment of capital. It has been demonstrated that capital could be profitably invested, and that a conservative management of an Independent telephone property at rates far below the standard obtaining during the many years of Bell control, meant a safe investment, absolute protection and more than satisfactory dividends. It was bona fide proof of success with regard to the Independent telephone work, which led to the operation and control of these properties by some of our most prominent and wealthy men, and their management has shown a fairness and honesty of purpose in the development of the work that the Bell company have found it impossible to successfully meet.

The Independent telephone movement began in 1894. Since that time manufacturers of Independent telephone apparatus have sold several millions of telephones and many thousands of switchboards for Independent plants, and if a careful, considerate estimate be made of the failures in any other legitimate commercial line covering the same period of time and with the same amount of capital invested (and this includes our banking institutions), the result is indeed favorable to the Independent telephone investor. With a few exceptions there has been a comparative freedom from disasters in the telephone field, and the few failures cited by the Bell company as a basis for its argument against the onward movement of the Independent cause are without weight. I believe the financial history of our country will nowhere show a more honest, legitimate paying proposition than that which can be found in the Independent telephone field. This statement is based on reports at hand, relative to earnings, and to the benefits conferred upon a vast number of communities.

Among other cities in the far West, Baker City is cited as not wanting a new telephone system, and it is stated in the pamphlet to which I have referred heretofore in this series of articles that a franchise was denied the applicants for an Independent telephone plant. I have recently learned that a franchise had been granted to some fifteen reputable business men of Baker City and vicinity to install a telephone exchange, and that a franchise has also been granted to a number of the same parties for an exchange at Sumter. It would seem, therefore, that while objections were raised to an Independent system, the movement found favor with a majority, and we can look for the installation of modern Independent plants in these two cities in the very near future. A contract has just been awarded for the complete equipment for an exchange to be located at Redlands, Cal. A franchise has been secured at Oakland, Cal., and with the gradual development of the Independent work along the Pacific Coast, active measures will soon be taken in Oakland and a modern plant will be constructed in that city. It is to be assumed that some little time will be required to educate the people of our Western cities to the wonderful benefits which have come to the masses through

*Editor's Note: This is the second of a series of papers by Mr. Nate.

Independent telephony; but the work is surely and earnestly going forward. As an illustration of the possibilities in this direction, we may take Los Angeles as a fair example. This city was worked in the interests of an Independent telephone company nearly four years ago. The promoters, however, were known to have been connected with other schemes of like character, San Jose, for instance. Their schemes were not altogether rosy, especially when the cost of operation, maintenance, depreciation and dividends were considered in connection with the rates proposed. At the same time the Pacific Bell company was also very bitter in its attacks on the movement, and the combination of these several conditions resulted in a failure of the effort to organize an Independent company at that time, and the work was finally given up. Remember, this was only a few years ago. To-day the citizens of Los Angeles, with a broader knowledge of what has been accomplished in the Independent field, and a more complete appreciation of its benefits, have signed with the Los Angeles Home Telephone Company for thousands of telephones and a new exchange is installed. The original arrangement for 6,000 subscribers, not being sufficient to take care of the 15,000 thus far secured, the ultimate capacity of the switchboard has been increased to many thousands more.

Telephone construction companies are being organized throughout the west for the establishment of toll lines and Independent exchange plants, and in the very near future will be at work on long distance Independent toll lines of first-class construction. Over these lines A1 telephone service will be furnished—a service which will more than favorably compare with the work of the Bell company in the past, and, if history shall repeat itself, Independent toll line properties in the west will outgrow those of the Bell company as they have already done in the central states.

True, distances are great in the West, and it may be that activity on the part of the Independent will compel some concessions from the Bell company, which will obviate the necessity of constructing a duplicate set of wires for those longer circuits where towns or cities to be connected are few and far between.

This can be considered as more than a possibility, because it is being done elsewhere. In Kentucky, for instance, from Vanceburg (near Maysville), forty towns and cities are equipped with toll apparatus, and service is given in combination over both Independent and the Bell company long distance lines. The local company is supplying service to forty different stations located in the following counties: Bracken, Fleming, Bath, Mason, Robertson and Nicholas. Prominent towns incorporated in their system are Lexington, Mt. Sterling, Winchester, Germantown and others, and in the catalogues distributed by the Independent company operating in these towns appears the following, relative to toll-line service: "Service through Maysville over Kentucky Independent telephone lines to all points in Kentucky. Service over American Telephone and Telegraph lines and Central Union Telephone Company's lines to all points in the United States."

Does this look as if the American Bell Telephone Company is telling the truth all the time? Bell instruments only are employed at toll stations. Telephones used locally in the various exchanges are of Independent manufacture.

Capital along the Pacific coast is waking up to the fact that Independent properties are paying investments, and that what has been so successfully accomplished in other parts of the country can be duplicated in the far west. So the movement is going earnestly ahead with that end in view. There have been in the west some striking verifications of this statement. Take as an illustration Boise City, Idaho, in which over three years ago was established a modern telephone plant of some 300 subscribers. This plant has grown to 1,150 subscribers since that installation with a complete system of toll lines reaching out into the state for 184 miles. The long-distance company which is operating at Boise City is at the present time promoting extensions to its lines, and is building two hundred miles of additional lines, while the coming installation of an Independent exchange at Salt Lake City, Utah, means communication between these two points this summer.

Billings, Montana, may be cited as another instance. This is one of the exchanges which the Bell company should have listed as having gone out of business. Its history is briefly this: In October, 1894, a franchise was granted. A company of local business men was formed to build the exchange. In April, 1901, the stock of this company was sold to the Bell company. One of the owners of that stock, realizing that the first movement had not been successful, and that people would support another Independent exchange, made application for a second franchise, and it was granted. From the early beginning of the movement in Billings the promoters were threatened with all kinds of litigation by the Bell company; but nothing was really done. This exchange was probably the pioneer exchange in the West. In December, 1902, the second Independent exchange was installed with less than 200 subscribers. March, 1903, an order for an additional section of switchboard was placed, together with an order for the necessary number of instruments, and the increase of orders has been far in excess of all anticipations, the company being unable to keep up with the demands. Bell telephones are coming out in large numbers and being replaced with Independent instruments.

I have, with few exceptions so far, confined myself to Western territory, and have touched more particularly upon the work of the Independents with relation to those towns and cities referred to in the pamphlet from which I have made extracts; and I may have occasion to refer again to this production of the Bell company's palpably warped views. I regret extremely that the field to be covered is so wide. There are so many points to be dealt with in connection with the work of the Independent telephone companies that condensation to any great extent is not to be considered.

In connection with this work, I may say that while our larger companies are officered by men who are fully alive to much that has been accomplished in the Independent field, among smaller organizations and prospective investors are many who perhaps will find in a larger and more detailed statement not a little valuable information.

I stated in a previous paper that the Bell company is unquestionably responsible for the distribution of a class of literature calculated to retard and hamper the work of the Independents, and that nowhere could I find a manly defence in connection with such productions over the signature of the Bell monopoly. It is with some degree of pleasure that I admit having received, a few days ago, another thirty-page pamphlet entitled "Monopoly Competition as It Relates to the Telephone Business," compiled by the Wisconsin Telephone Company.

Having spent a number of years in the state of Wisconsin, and possessing a close knowledge of much that has been accomplished in that state, I shall deal frankly a little later on with the situation in Wisconsin, and I am glad that the Wisconsin Bell company has prepared an argument covering this territory which can be openly attributed to the source from which it emanated. This pamphlet is undoubtedly due to a natural desire on the Bell company's part to discourage the granting of a franchise in the city of Milwaukee, and as an appeal to the legislature now in session and before which are several bills with regard to telephone rates and similar matters.

Some very hard things have been said by our common enemy with regard to the class of construction employed by Independents, and wherever a poorly constructed plant is known, it has been brought prominently before the coun-

cils of the different towns, cities and villages in which franchise privileges have been solicited. The Bell claim is that the coming of a second telephone exchange means unsightly streets, a duplication of pole line construction, and that in general our workmanship is bad and our material cheap. I am prepared to admit that in 1894 and 1895 and, in fact, up to the time when modern apparatus made its appearance in the Independent field and during the years that the Independent cause struggled against a most unfavorable condition of affairs, following the panic of 1893, there was a great deal of inferior construction work performed; but how about the Bell company's work and service during the same years? If there is one proof stronger than another as to the legitimate earning capacity of Independent telephone properties, it lies in the fact that immediately following the panic of 1893 Independent telephony came into life, and has gone steadily on to success until its prestige to-day can not be questioned. I do not mean by this statement that we have succeeded in covering the entire country. Far from it; but we are certainly "getting there," and in a most substantial manner. Referring again to the matter of construction, I would call attention to the fact that the Independent telephone construction companies and exchange owners have been the leaders in the work of modern construction in our smaller towns and cities, and what work they have performed in the larger cities has been of a most substantial, reliable and thorough character. If I can be shown a single instance wherein the Bell company in the history of its monopoly ever placed underground its wires and cables in conduits in towns of 25,000 or less until the Independent companies compelled it to do so, I shall have learned something. It was the high grade of construction employed in more recent years by the Independents in the building up of their plants in such cities as Fort Wayne, South Bend, Muncie and many other towns of corresponding population that compelled the Bell company to do likewise or quit the field. There are even instances on record —such towns as Madison and La Crosse, Wis., for instance —where the Bell company invested hundreds of thousands of dollars in the re-construction of its property, purchased ground and erected buildings, and yet to no purpose. As a matter of fact, there is no modern Independent plant which has been installed within the last eighteen months, or is in course of construction to-day, in which the best of material and apparatus has not been employed, and in connection with this work the best of engineering advice has been sought and followed out.

The Independents have not tried to cover up the fact that the poor construction of earlier years handicapped them and added much cost to the reconstruction and maintenance expense account. It is because of these experiences that such cities as Indianapolis, St. Paul, Minneapolis, Buffalo, Cleveland, Pittsburgh, Rochester and many other of our large cities in which the Independents are firmly established, have constructed magnificent underground plants, purchased ground, and erected substantial and suitable buildings for exchange and general office purposes.

Excepting in a few of our large cities, it will be found that the Bell company owned very little real-estate during all the years of its monopoly. It is only since the coming of the Independent movement that it has felt called upon to buy property in many of the smaller cities in which it had been operating, and in a large number of instances without a franchise of any character whatsoever.

A common claim made by the Bell company is with regard to the inability of the Independents to successfully exist at the rates charged for telephone service, and the few failures in the Independent field which have occurred are aired freely, and glaringly set forth.

It seems almost beyond belief to the uninitiated, but a careful and conservative review of the financial affairs of the Independent telephone industry covering a period of the last eight years will show a most favorable condition. As heretofore stated, the percentage of failures among our national banks has been greater than in Independent telephone investments. And when one stops to consider that around the banks of this country is thrown a protective law, which should at least reduce to a minimum any question of failure, the claim of our common enemy that we are a lot of dreamers, and that our work could not live, is idle; and, considering the $300,000,000 or more now invested in the Independent cause, we have from a financial standpoint the best of the argument. However, before going too far into details along these lines, it would be well at this point to show broadly something of the work accomplished by the Independent telephone companies. Realizing that a general statement is stronger when substantiated by figures, I propose to furnish a few statistics showing what has been accomplished in the Independent field—as to the number of exchanges, rates, earnings, capacities, class of construction, toll-line advantages and progress of the movement generally.

I may, in the compilation of the list of exchanges, be at fault with regard to a few cities listed, simply because I have not time to wait for complete data. There are at the present time in operation in the United States over 5,000 Independent telephone exchanges. Many of these are small, of course; but we can safely take as the average number of telephones to each exchange three hundred, or, in round numbers, one and a half million telephones in exchange service. At least another million may be added, representing the sale of telephones to farmers, hotels, offices, factories, mines and railroad companies, or a grand total of two and a half millions.

A further proof of the immense growth of the Independent telephone work can be found in the fact that the combined output of the Independent manufacturers during the year 1902, according to the report of sales, shows an average daily output the entire year of 1,500 telephones, or practically 550,000 telephones for the year. During the busy months of the season several of the larger factories were turning out daily between 500 and 600 telephones, and this output continued for many months, while all of the smaller concerns were crowded to their full capacity, turning out daily anywhere from 50 to 200 telephones. These are figures which can be substantiated. If this is what was accomplished last year, it is not difficult to appreciate that the sales of preceding years would easily make up the difference required to give us the estimated total number of two and a half million telephones now in service. This is indeed a remarkable showing, more particularly when one stops to consider that the total number of Bell telephones in service at the end of the seventeen years' monopoly did not exceed a half million. Verily the people have suffered long for a telephone service which might have been furnished by the Bell company years ago. We can safely admit a small loss on account of failures and some duplication; but we still have, as against this condition, a number of large controlling companies who operate a great many sub-exchanges which do not appear in the list. Take, for instance, the City of Cleveland, in which three prominent companies are located, controlling a large number of sub-exchanges. To illustrate, the Federal Telephone Company's plants or properties in which they are largely interested are located at Alliance, Bowling Green, Canton, Cleveland, Columbus, Findlay, Fostoria, Lancaster, Lima, Massillon, Mansfield, Salem, Youngstown, Zanesville and Logan.

Pittsburgh is listed as but one of the total number of exchanges, whereas the Pittsburgh & Allegheny Company is operating exchanges in twenty-two towns including such cities as Beaver Falls, McKeesport, Carnegie, etc. The United Telegraph and Telephone Company, Philadelphia, owns and operates, in part, over 100 exchanges, including

some of the most prominent towns and cities in Pennsylvania. If any further doubt exists as to what has been accomplished by the Independent companies, the following numeral list of the cities and towns in which exchanges are in operation should be conclusive. In making mention of a few of the more prominent points equipped with Independent apparatus, it is possible that some of the larger plants may be overlooked. Later, attention will be paid to the small exchanges, that is, where the list numbers from 500 to 2,500 subscribers, or in towns and cities of from 10,000 to 25,000 population:

ALABAMA (34 Exchanges)—Principal exchanges installed and in operation: Birmingham, Columbia, Tuscaloosa, Athens.

ALASKA (5)—Juneau, Skagway, Circle City.

ARIZONA (10)—Flagstaff, Uma, Phœnix, Prescott.

ARKANSAS (57)—Eureka Springs, Harrison, Little Rock, Pine Bluff, Van Buren, Iron Mountain.

CALIFORNIA (68)—Los Angeles, Sacramento, Pasadena; contracts now being placed for exchanges at Redlands and Oakland.

COLORADO (23)—Ft. Morgan, Greeley, Telluride, Central City.

CONNECTICUT (21)—Danbury, Sharon.

DELAWARE (10)—Dover, Wilmington.

FLORIDA (27)—Jacksonville, Tampa, Tallahassee, Palm Beach.

GEORGIA (101)—Atlanta, Columbia, Savannah, Tallapoosa, Mason.

IDAHO (9)—Boise, Kendrick, Pocatella.

ILLINOIS (482)—Aurora, Bloomington, Cairo, Decatur, Galesburg, Jacksonville, Kankakee, Peoria, Rockford, Rock Island, Lincoln, Springfield.

INDIANA (350)—Ft. Wayne, Indianapolis, Lafayette, Logansport, Michigan City, Muncie, New Albany, South Bend, Terre Haute, Kokomo, Anderson, Richmond.

INDIAN TERRITORY (26)—Muskogee, South McAllister.

IOWA (433)—Cedar Rapids, Decorah, Des Moines, Ft. Dodge, Marshalltown, Oscaloosa, Ottumwa, Sioux Falls, Waterloo, Clinton, Davenport.

KANSAS (151)—Chanute, Coffeyville, Kansas City (being installed), Leavenworth, Wichita, Topeka, Atchison.

KENTUCKY (97)—Bowling Green, Frankfort, Lexington, Louisville, Owensboro, Paducah, Paris, Shelbyville.

LOUISIANA (15)—Natchez, Shreveport, Baton Rouge.

MAINE (59)—Augusta, Lewiston, Portland, Yarmouth.

MARYLAND (47)—Baltimore, Cumberland, Hagerstown, Fredericksburg.

MASSACHUSETTS (36)—Fall River, Plymouth, Nantucket.

MICHIGAN (184)—Adrian, Alpena, Battle Creek, Benton Harbor, St. Joseph, Cheboygan, Grand Rapids, Muskegon, Saginaw, Bay City.

MINNESOTA (174)—Albert Lea, Mankato, Minneapolis, Owatona, St. Paul, Winnebago City, Duluth.

MISSISSIPPI (48)—Columbus, Holly Springs, Mason, Natchez, Yazoo City.

MISSOURI (123)—Joplin, St. Joseph, St. Louis, Sedalia, Hamilton, Springfield, Chillicothe.

MONTANA (17)—Billings, Chinook.

NEBRASKA (95)—Fremont, Hastings, North Platte, Pawnee City.

NEVADA (3)—Carson City, Reno.

NEW HAMPSHIRE (24)—Bradford, Canterbury, Exeter, Johnsborough.

NEW JERSEY (60)—Asbury Park, Camden, Newark, Paterson, Trenton, Atlantic City, Jersey City.

NEW MEXICO (10)—Albuquerque, East Las Vegas, Santa Fe.

NEW YORK (292)—Albany, Auburn, Binghamton, Buffalo, Delhi, Gloversville, Jamestown, Johnstown, Niagara Falls, Ogdensburg, Oswego, Poughkeepsie, Rochester, Saratoga, Troy, Utica, Syracuse.

NORTH CAROLINA (94)—Asheville, Charlotte, Durham, Salisbury, Tarboro, Greensborough.

NORTH DAKOTA (32)—Bismarck, Devils Lake, Fergus, Grand Forks, Hope.

OHIO (367)—Akron, Canton, Cleveland, Columbus, Dayton, Hamilton, Lima, Mansfield, Piqua, Sandusky, Zanesville, Toledo, Youngstown, Warren, Xenia.

OKLAHOMA (31)—Guthrie, Oklahoma, Perry, Shawnee.

OREGON (32)—Baker City, McMinnville, Portland, Salem.

PENNSYLVANIA (328)—Allegheny, Altoona, Braddock, Chambersburg, Harrisburg, McKeesport, Philadelphia, Pittsburg, Scranton, Wilkesbarre, York.

SOUTH CAROLINA (52)—Charleston, Georgetown, Hamilton, Princeton, Sumpter, Waynesboro.

SOUTH DAKOTA (73)—Aberdeen, Chamberlain, Colmon, Deadwood, Hurley, Pierre, Sioux Falls, Watertown, Yankton.

TENNESSEE (78)—Athens, Huntingdon, Jackson, Knoxville, McMinnville, Memphis, Shelbyville.

TEXAS (160)—Austin, Beaumont, Cleburne, Denison, El Paso, Houston, Orange, Port Arthur, San Antonio, Waco.

UTAH (2)—Reno, Ogden.

VERMONT (53)—Brandon, Bristol, Middlebury, Middlesex, Newport, Wilmington, Burlington, Jonesville, Northfield.

VIRGINIA (93)—Lexington, Lynchburg, Norfolk, Richmond, Roanoke, Staunton, Williamsburg, Newport News, Hampton.

WEST VIRGINIA (72)—Clarksburg, Fairmont, Grafton, Huntington, Mannington, Morgantown, Parkersburg, Wheeling, Charleston.

WISCONSIN (200)—Appleton, Baraboo, Beloit, Fond du Lac, Janesville, La Crosse, Madison, Monroe, Neillsville, Sheboygan, Wausau, West Superior, Racine, Ashland.

WYOMING (7)—Medicine Bow, Pawnee City, Laramie, Cheyenne.

In the classification of the many exchanges in operation in the Independent field, a duplication of names must necessarily appear, but in order that the work accomplished by the Independents may be appreciated, a sub-division becomes necessary. The following is a list of cities having a population of 25,000 or more. There are in the United States, according to the census of 1900, 180 cities having a greater population than 25,000 inhabitants. Of these 108 are equipped with Independent telephone exchange apparatus. The list is as follows:

Akron, Ohio; Albany, N. Y.; Allegheny, Allentown and Altoona, Pa.; Atlanta, Ga.; Auburn, N. Y.; Augusta, Ga.; Austin, Texas; Baltimore, Md.; Bay City and Battle Creek, Mich.; Binghamton, N. Y.; Birmingham, Ala.; Bloomington, Ill.; Boston, Mass.; Buffalo, N. Y.; Camden, N. J.; Canton, O.; Clinton and Cedar Rapids, Ia.; Charleston, S. C.; Chester, Pa.; Chicago, Ill.; Cleveland and Columbus, Ohio; Covington, Ky.; Davenport, Ia.; Dayton, Ohio; Des Moines, Ia.; Duluth, Minn.; East St. Louis, Ill.; Easton, Pa.; Elizabeth, N. J.; Elmira, N. Y.; Erie, Pa.; Fall River, Mass.; Fort Wayne, Ind.; Grand Rapids, Mich.; Harrisburg, Pa.; Houston, Tex.; Indianapolis, Ind.; Jersey City, N. J.; Jackson, Mich.; Jacksonville, Fla.; Johnstown, Pa.; Joliet, Ill.; Knoxville, Tenn.; Kansas City, Kans.; La Crosse, Wis.; Lancaster, Pa.; Lexington, Ky.; Little Rock, Ark.; Los Angeles, Cal.; Louisville, Ky.; McKeesport, Pa.; Memphis, Tenn.; Mobile, Ala.; Nashville, Tenn.; Newark, N. J.; New Castle, Pa.; Norfolk, Va.; Orange, N. J.; Oswego, N. Y.; Paterson and Passaic, N. J.; Pawtucket, R. I.; Philadelphia and Pittsburg, Pa.; Portland, Ore.; Portland, Me.; Racine, Wis.; Reading, Pa.; Richmond, Va.; Rochester, N. Y.; Rockford, Ill.; Sacramento, Cal.; Saginaw, Mich.; St. Joseph and St. Louis, Mo.; St. Paul, Minn.; San Antonio, Texas; Savannah, Ga.; Schnectady, N. Y.; Scranton, Pa.; Seattle, Wash.; Sheboygan, Wis.; South Bend, Ind.; Springfield, Ohio; Superior City, Wis.; Syracuse, N. Y.; Terre Haute, Ind.; Toledo, Ohio; Topeka, Kan.; Utica and Troy, N. Y.; West Superior, Wis.; Wheeling, W. Va.; Wilkesbarre, Williamsport and Wilmington, Pa.; Yonkers, N. Y.; York, Pa.; Youngstown and Zanesville, Ohio.

Contracts have been placed for switchboards and telephones and the work is well under way in Atlantic City, N. J.; Kansas City, Mo.; Peoria, and Springfield, Ill.

Franchises have been granted with full rights to construct Independent exchanges and work will proceed without delay in nearly all of these points: Amsterdam, N. Y.; Cincinnati, Ohio; Fort Worth, Texas; Lincoln, Neb.; Oakland, Calif.; Denver, Colo.; Salt Lake City, Utah; San Francisco, Cal.; Tacomah, Wash.; Dallas, Texas; Detroit, Mich.

Applications for franchise for the construction of Independent telephone systems are at the present time before the city councils in Butte, Mont.; Council Bluffs, Iowa; Evansville, Ind.; Galveston, Texas; Milwaukee, Wis.; Omaha, Neb.; Oshkosh, Wis.; Pueblo, Colo.; Quincy, Ill.; Sioux City, Ia.; South Omaha, Neb.; Spokane, Wash.

Cities in which no active measures have been taken on the part of the Independents other than in the East are: Chattanooga, Tenn.; Montgomery, Ala.; New Orleans, La.; Newport, Ky.; Tacoma, Wash.; Washington, D. C.

A complete list of cities of 25,000 population and over in the East and in which there are no Independent exchange plants and in which no active work has been undertaken, is as follows:

Bayonne, N. J.; Bridgeport, Conn.; Brockton, Cambridge, Chelsea, Fitchburg and Gloucester, Mass.; Hartford, Conn.; Haverhill, Mass.; Hoboken, N. J.; Holyoke, Mass.; Kingston, N. Y.; Lawrence and Lowell, Mass.; Lewiston, Me.; Lynn and Malden, Mass.; Manchester, N. H.; Meridian, Conn.; North Adams and New Bed-

ford, Mass.; New Britton and New Haven, Conn.; Nashua, N. H.; New York city, Newbury and Brooklyn, N. Y.; Newton, Mass.; Providence, R. I.; Quincy, Mass.; Richmond, N. Y.; Salem, Somerville, Springfield and Taunton, Mass.; Waterbury, Conn.; Woonsocket, R. I.; Waltham and Worcester, Mass.

Recapitulation: We have 108 exchanges in which Independent apparatus is installed to-day; four cities where Independent apparatus is now being installed and where contracts have been let for the equipment; eleven cities in which franchises have been granted and in most of which the construction work will proceed without delay; twelve cities in which applications have been made for franchises and which are before the councils at the present time; six cities in which efforts have been made to secure franchises and where in one instance at least there has been an Independent plant; Eastern cities in which very little work has been done by the Independents at the present time, 39; grand total, 180.

In the list of cities enumerated there have been failures and some money has been lost; but despite the troubles experienced, the Independent work is going steadily forward, and is gainnig ground every day. One of the most striking arguments advanced by the Independents can be found in the fact that there are in this country a large number of places where, from one cause or another, the first exchange organization ceased to do business, and which are to-day equipped with modern apparatus, in full operation and having a larger list of subscribers than before. The list includes such cities as Shreveport, La.; Muncie and Elwood, Ind.; Toledo, Ohio.; Jackson, Mich.; South Bend and Logansport, Ind.; Findlay, Ohio; Kalamazoo, Mich.; Bowling Green, Ky.; Topeka, Kans.

The Detroit People's Company has already invested upwards of $400,000 toward the building of a new Independent system. A delay ensued here, the nature of which is pretty well understood. I refer to the Everett-Moore syndicate troubles of some two years ago. It was known that investigation developed the fact that the telephone properties controlled by this syndicate were really the profitable end of its investment.

Oshkosh, Wisconsin, is a point where the Independents are trying at the present time to secure a franchise because it is a link in a chain of places which will complete Independent service over a desirable section of that state.

We are told that Richmond, Va., has recently sold out to the Bell company. Accepting the statement as true, history will repeat itself in Richmond, and it will not be many years before a better and more modern Independent plant is constructed in that city.

As an example of what has been accomplished, let us take Kokomo, Ind., as an illustration. From 1878 to 1893 the Bell company had in operation probably less than 100 telephones. At the time of the Independent agitation, threats and misrepresentations by the Bell company, low rates, etc., secured for them something over 200 subscribers. An Independent exchange was constructed and has to-day in operation over 2,000 instruments. The average rate of rental is just about one-third of that collected by the Bell company under the old condition of affairs.

Speaking of Indiana, we might refer to it as it was and as it is now. Such towns as Richmond, Lebanon, Noblesville, Hartford City, Bluffton, Huntington, Decatur and Valparaiso are all equipped to-day with successful Independent telephone exchanges. It is worthy of note that some years ago when the Indiana legislature passed a bill compelling the Bell company to reduce its rates to $3.00 per month, telephones were taken out and many plants abandoned. Valparaiso was one of the towns, and many years elapsed before service came back to that progressive little city. In this list of Indiana towns there are a few wherein telephone service was never furnished until the Independents made it possible. I shall, for the purpose of illustrating the growth of Independent exchange work, list a number of cities and towns, showing as far as possible date of installation, the number of Independent telephones first installed, number the Bell company had in service at that time, number of Independent telephones now in operation, and the number of Bell telephones now furnishing service, paid and otherwise. These figures are compiled from statements furnished by exchange owners and operators, and are practically accurate. The list is a very long one, and only a part is shown for the purpose of illustration:

Name of Exchange	Year installed	No. of Ind. 'phones installed.	No. of Bell 'phones installed.	No. of Ind. 'phones now operating,	No. of Bell 'phones now operating.
Belle Plaine, Ia.	1898	60	25	365	0
Iowa Falls, Ia.	1900	125	125	375	75
Hampton, Ia.	1900	100	125	350	50
Eagle Grove, Ia.	1900	150	125	400	80
Centerville, Ia.	1900	150	150	550	10
Harlan, Ia.	1900	100	60	330	5
Newton, Ia.	1901	250	115	525	25
Grinnell, Ia.	1901	125	130	425	50
Anamosa, Ia.	1902	100	125	300	150
Monticello, Ia.	1902	100	100	175	100
Mt. Pleasant, Ia.	1902	150	80	400	50
Red Oak, Ia.	1902	150	250	400	175
Shenandoah, Ia.	1902	200	325	450	225
Totals		1760	1735	5045	995

To this list might be added:

Gladbrook, present installation	100
Marengo, present installation	200
Avoca, present installation	200
La Porte City, present installation	220
Colfax, present installation	200
Oakland, present installation	100

These are cities in which no telephone service has ever been furnished until the Independent people began, with the possible exception of Marengo, which had in the beginning about 15 telephones. La Porte City has 220 telephones in service, with a population of 1,500, which gives a telephone to every seven inhabitants:

Name of Exchange	No. of Ind. 'phones installed.	No. of Bell 'phones installed.	No. of Ind. 'phones now operating,	No. of Bell 'phones now operating.
Logansport, Ind.	200	800	1600	25
Mankato, Minn.	120	140	800	225
E. Las Vegas, N. M.	62	35	385	320
Texarkana, Ark.-Tex	300	700	840	500
Jackson, Mich.	1000	1750	1675	1100
Asheville, N. C.	300	340	1000	50
Zanesville, O.	1000	800	1200	*1600
Kokomo, Ind.	220	375	2000	145
Galesburg, Ill.	600	600	1700	..
Ottumwa, Ia.	300	300	1200	300
Jamestown, N. Y.	500	1000	1500	700
Appleton, Wis.	375	350	850	400
Lima, O.	240	210	1300	600
Nevada	..	..	450	50
Bismark, N. D.	..	..	225	..
Carthage, Mo.	..	..	700	75
Joplin, Mo.	..	..	1200	500

*The Janesville Company have on their list applications for 800 additional telephones, all of which will be added this coming season. The Bell company has been able to add to its list because upwards of 75 per cent of the service furnished is operated with four to ten parties on the same line.

Name of Exchange	No. of Ind. 'phones installed.	No. of Bell 'phones installed.	No. of Ind. 'phones now operating,	No. of Bell 'phones now operating.
Boise City, Idaho.	300	185	1150	600
Madison, Wis.	400	240	1750	600
Wausau, Wis.	110	200	600	14
Janesville, Wis.	380	225	900	450
Grand Rapids, Wis.	80	97	450	15
Monroe, Wis.	100	100	450	100
Racine, Wis.	500	900	1500	400
Marion, Ind.	572	960	1600	550
Huntington, Ind.	..	..	710	..
Bluffton, Ind.	..	..	403	..
Hartford	..	..	475	..
Mt. Pelier.	..	..	309	..
			28,472	9290

In Texas this list of towns equipped with modern apparatus takes in nearly every prominent city in the state, and does not include the hundreds of smaller exchanges: Dennison, Sherman, Paris, Texarkana, Ennis, Nacogdoches, Hillsboro, Waco, Belton, Temple, Taylor, Austin, Houston, Port Arthur, Beaumont, Lockport, Tyler.

The present season will see completed in connection with the Texas exchanges toll lines which will furnish direct service to Kansas City, St. Louis, Arkansas City, Little Rock, Memphis, Fort Smith, Galveston, New Orleans. Over half the system is at the present time constructed and first-class service is being furnished.

After one has carefully gone over such a list with its magnificent showing he is in a position to judge conscientiously and accurately as to the truth of the statements made both by the Bell and the Independent telephone companies.

As to the question of two telephone systems in one town or city, many answers are applicable and the statement may be broadly made that it is not necessary, because the Independents are supplying service to more subscribers at lower rates, and are building more and better lines to-day for toll-line service as far away from any given town as most people care to talk. Let us suppose that two telephone systems are installed; it simply means that you pay practically as much for two telephones as you would for one if the Bell controlled the field. Perhaps it is a good thing to have two systems. We are sure that because of the fact that one railroad entered a town, we would not drive another away if it sought the privilege of passing through. We would not hinder a second express company from coming into our midst, nor would we hold out the Postal Telegraph Company in competition with the Western Union. One grocery store might satisfy us; but we really prefer the annoyance of two because of better goods at lower prices. We have learned that competition in all lines reduces cost to the consumer, and if it makes talk cheaper, the inconvenience of having two telephones is more imaginary than real.

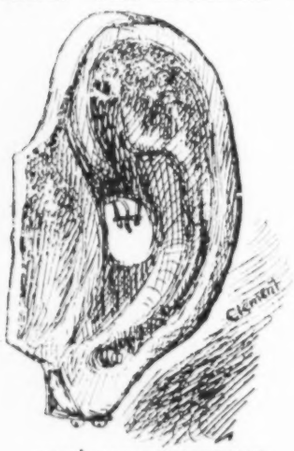
A few years ago an article appeared, written by a prominent Bell company official, entitled "The Telephone Door," setting forth the great advantages of the telephone and its effects on the commercial and social world and the opportunities that it opened up in all lines. Since the Independent movement has gained strength, the Bell telephone door has been opened to its own selfish interests only, but the telephone door in the Independent field has opened up a proposition for the consideration of the Bell company, which has given them much food for thought. It remained for the progressive independent spirit of the abused American citizen to teach them a lesson which in their arrogance they believed to be an utter impossibility.

In conclusion, we may quote Abraham Lincoln, "You may fool all the people some of the time and some of the people all the time, but you can't fool all the people all the time," and that is precisely what the Bell company has been trying to do.

Anthropomorphic Telephony.

By Edward E. Clement.

The very first telephone ever made was formed from a beer-bung hollowed out, with a diaphragm formed of the skin of a German sausage. To this was fixed, with a drop of sealing wax, a little strip of platinum that corresponded to the *malleus* of the human ear, and a second contact completed the circuit. The receiver was a knitting needle, wound with wire, and mounted on a violin as a sounding board. This instrument is now in the possession of the telegraph department of the German government. If it did nothing else, it proclaimed to the world that the telephone is, and of necessity must ever be, of Teutonic origin. We might question the violin or the knitting needle; but surely no one can successfully contend for a moment against the sausage and the bung!



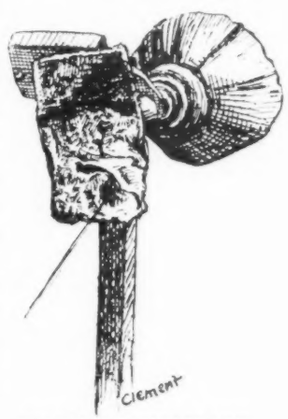
REIS' EAR TELEPHONE.

The most important statement, however, that Dr. Messel made in his account of this primordial instrument was that referring to Reis having copied the mechanism of the middle ear.

There is a tendency in all departures from convention in inventing, to copy nature, as a beginning. Bell did it as much as Reis, and phonograph inventors have imitated them.

Reis himself in one of his earliest models not only imitated the sound transmitting mechanism, the *malleus, incus* and *stapes,* but he also carved a rough model of the external ear, to which these parts are attached. The idea evidently was that the folds and convolutions of the external ear were intended by nature to strengthen and direct speech vibrations—as indeed they were; but he lost sight of the fact that our ears were originally more like those of the mouse; and that the present shape, particularly the lobe, is largely due to the savage habit of wearing earrings through a succession of generations.

Graham Bell says he was "much struck" by a certain form of phonograph, and it occurred to him that there was a remarkable likeness between the manner in which this piece of wood was vibrated by the membrane of the phonautograph and the manner in which the ossiculae of the human ear were moved by the tympanic membrane. He determined, like Reis, to imitate closely the mechanism of the ear, and for this purpose he sought the assistance of a distinguished aurist in Boston, Dr. Clarence J. Blake. The doctor suggested to him the use of a human ear itself instead of an imitation. The idea was novel and pleased Mr. Bell, and a specimen was prepared accordingly.



TELEPHONAUTOGRAPH.

They then mounted this, and the apparatus appeared as shown in our cut.

The *stapes* of the ear was removed, and a stylus of hay about an inch long was attached to the end of the incus. Upon moistening the drum and the little bones of this dead ear with a mixture of glycerine and water, the necessary mobility of the parts was obtained, and upon singing into the external ear the stylus of hay was thrown into vibration, and tracings were obtained on a piece of smoked glass passed along undereath it. This experi-

ment led to the attachment of an armature to a diaphragm, and thus to the operative telephone.

From these primitive experiments to the construction of an entire figure, man or animal, containing transmitting and receiving telephones in proper relation to the mouth and the ear, would seem a logical step, although not fraught with much of value, except from an aesthetic standpoint. To the artistic sense there is something very incongruous about one ear, or one eye, if intended for use, or show, anywhere outside of a surgeon's alcohol pickle bottle. It is necessary to have all the other component parts of, say, the head, to make a symmetrical creation. If Reis' original form of telephone had only had a complete head carved in imitation of his own, with a beer-barrel bung sticking out of (or into) each ear, the German sausage neatly installed in his capacious throat, and the knitting needle playing the

SECTION OF FOSTER'S TELEPHONE MAN.

part of a toothpick, what a soul-satisfying and characteristic picture, as well as complete instrument, would have been presented.

Apparently there are others who have experienced this feeling, and have aimed to supply a long-felt want, for a U. S. patent was issued in 1881 to a Mr. Gay W. Foster, for the "combination of an image representing a man or other object, with a speaking tube and electric telephonic transmitter."

The poetry of Mr. Foster's idea is marred, but not destroyed, by his representing a bear as the "other object" referred to. A sketch of the arrangement is shown below. It will be observed that all wires pass up the trouser leg, and are neatly concealed from view. The gentleman is provided with proper connections for his larynx, and taken altogether, he satisfies the "unities" quite well.

In this connection our attention has been attracted by a letter that appeared in an esteemed contemporary some time since. The letter is as follows:

To the Editor:

We read with much interest in your valued paper of the night service by the Telephone company.

We think we can go this one better. We have not only been giving all-night service and calling up our subscribers at any time of night, for more than a year, but have acted the part of nurse for our subscribers who have been sick and wanted to take medicine during the night, by calling them as often as once every hour.

Then, again, owing to the convenient construction of our telephone, having the receiver, transmitter and calling device all on one handle, with ten or more feet of cord, it enables our subscribers to take their telephone to bed with them, and when they are called, or wish to call central, all they have to do is to reach under their pillow and pull out the telephone without even getting out of bed. Can there be anything more convenient?

Home Telephone Company.

What a delightful vista of possibilities is opened to our gaze as we read this interesting letter. What a perfectly charming idea—the telephone as a nurse. Direct personification at your bedside of a beautiful young person, whose voice, at least, if not her warm life current, pulsates along the slender connecting link that binds you two momentarily together. How you cling to the vitified assortment of metal and rubber, seeming almost to feel that soft white hand upon your fevered brow; those tender eyes gazing into yours with the pity that is perilously akin to something else; that caressing—ah, what music there is in that voice,

THE TELEPHONIC NURSE.

sweet as an angel's—there is no imagination about that. It is the great piece of reality about your sickness. At any moment if you chance to feel nervous or unquiet, you can take that lovely, calming combination of dulcet tones from beneath your pillow, where you keep it all the time. What matter it that you fumble only a cold mass of screws and magnets and wire. She is at the other end. Virtually locked up in your hand is that fairy indefinite femininity that every man longs for with a mighty longing when his stomach is wrong or his liver aches, and that attains in just such a condition of affairs her very highest idealistic development. But why should this precious combination of girl and telephone, of iron bars and aproned nurse, be put into such an ugly form? Why not idealize our Alabama friend's telephone nurse in very truth.

Mr. Foster has given us a hint that we should not neglect—there is only one flaw in his conception. When a man is mentioned as being the preferred receptacle for the telephone set, the natural supposition on reading the claim

would be that the "other object" could be no other than woman, lovely woman. But, no, Mr. Foster's imagination could conceive no higher alternative than a bear, just a common, ugly, hog bear, that no one, sick or well, would want around.

To illustrate our ideas, we present drawing of the proper arrangement of this matter. By very little stretch of mechanical ingenuity Miss Telephone could not only say "take your medicine," but controlled from central she could give it to you. That is our conception of a telephone nurse. And she could talk sweetly to you (from central, of course) while doing so.

The materials in which Miss Telephone could be furnished would necessarily vary with the taste and means of the subscriber.

The cheaper forms could be papier mache, which they make up and color in France to imitate nature very correctly. From this the choice would range up through bisque, porcelain or silver to the real American flesh and blood.

With such an achievement to admire, cherish and talk to (and turn a switch when you are tired of its talk, and so promptly stop it)—away with praise of Memnon and his piercing, sunrise note; of Isis and her talking images! The greatest marvel of the ages will be Miss Telephone—the anthropomorphic incarnation of a voice—a sweet American voice.

PRACTICAL TELEPHONY

Conducted by P. KERR HIGGINS, A. M. I. E. E.

ARTICLE VI.

Pole Top Terminals.—In article V. of this series the use of the pole top terminal was overlooked. These are coming more and more into use, and for distribution poles and aerial construction they have no equal. Their neatness and serviceability are at once apparent from the photograph (Fig. 1). The connection between the terminal and the cross-arms or distributing ring, as the case may be, is made by means of No. 19 (rubber) saturated duplex, weatherproofed, and the whole presents very neat workmanship. Great care must be had in soldering in the connection; only the very best non-acid flux should be used, making the solder "sweat in" well. The use of screws and washers in the terminals is poor practice, and will cause much trouble, especially on common-battery systems, from oxidation, producing opens, cutouts and other annoying troubles, hard to locate because of their intermittent character.

Underground Cables.—It is desirable for efficiency, if for no other reason, to use underground cable wherever possible and practicable to do so; but the matter of the exact point where the underground should terminate and the aerial begin must be decided in each case separately. In laying out the underground plant it is wise to plan for a subway large enough to take care of future growth, for the reason that the largest portion of the expense will probably be in the excavating and manholes, and the cost per duct foot will be reduced as the number of ducts is increased. The cost of manholes, in great measure, is also common to large and small systems. By doing this any future tearing up of streets is dispensed with. The construction of conduits requires experience in order to save money and obtain the best results. The laying of ducts in a haphazard way has been the cause of considerable loss to many companies, and I take this opportunity of warning those arranging for such work that only an experienced engineer should be employed. The average depth of the trench should be about four feet, varying according to conditions. Before digging trenches test holes should be dug to locate pipes, etc. The trench should be about six inches wider than the duct bed, and the grade so arranged as to drain to one manhole. Many different styles of conduit have been experimented with, including paper, but to-day there is really nothing in the market to compare with vitrified tile of one form or another. This is made up in single or in multiple ducts (Fig. 2) of the very best glazed clay, and molded so as to form a hollow center (three inches in diameter), capable of admitting our largest cables, and are usually made in lengths of eighteen inches. These are rendered impervious to moisture, the interior being made smooth so as not to injure the cable.

It is usual in constructing the conduits to clean out all ducts by means of a mandrill fitted with a leather washer. These are laid in a straight line on a bed composed of cement and broken stone, and three inches thick. All joints, sides and top and intermediate layers must be thoroughly covered with cement. This is necessary to prevent outside injury. All joints must be broken in each layer. The single duct is most popular because of its flexibility, permitting the passing of water pipes and other obstructions with the greatest ease. In the event of repairs being necessary, the cost is less, and, besides, they are more easily replaced. As each section of the work is completed, all the ducts should be tested and cleaned out and the ends plugged up with wooden plugs. This is also done at the end of each day's work. The conduit when complete and

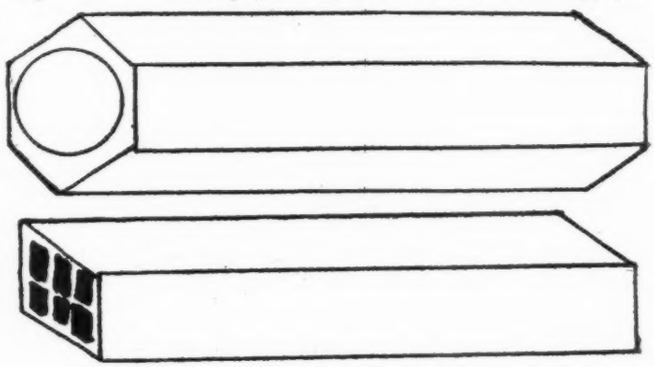


FIG. 2—SINGLE AND MULTIPLE DUCTS.

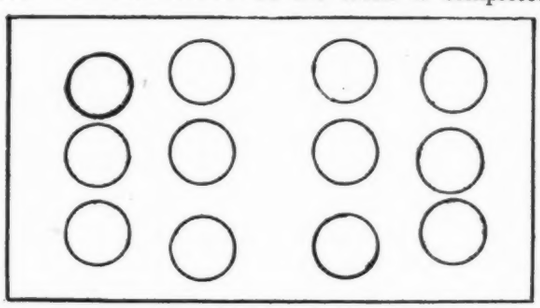


FIG. 3—ARRANGEMENT OF DUCTS AT MANHOLE.

set should form a solid cement mass at least three inches thick all around before the ducts are reached, so that should street or pipe repairs render undermining necessary the concrete body will sustain the ducts without any other support. On reaching the manholes the ducts should be staggered (Fig. 3). It is customary to use iron pipe for short laterals to poles; but its extended use is not desirable.

There is a difference of opinion as to whether it is best to place the conduit above or below service pipes. But,

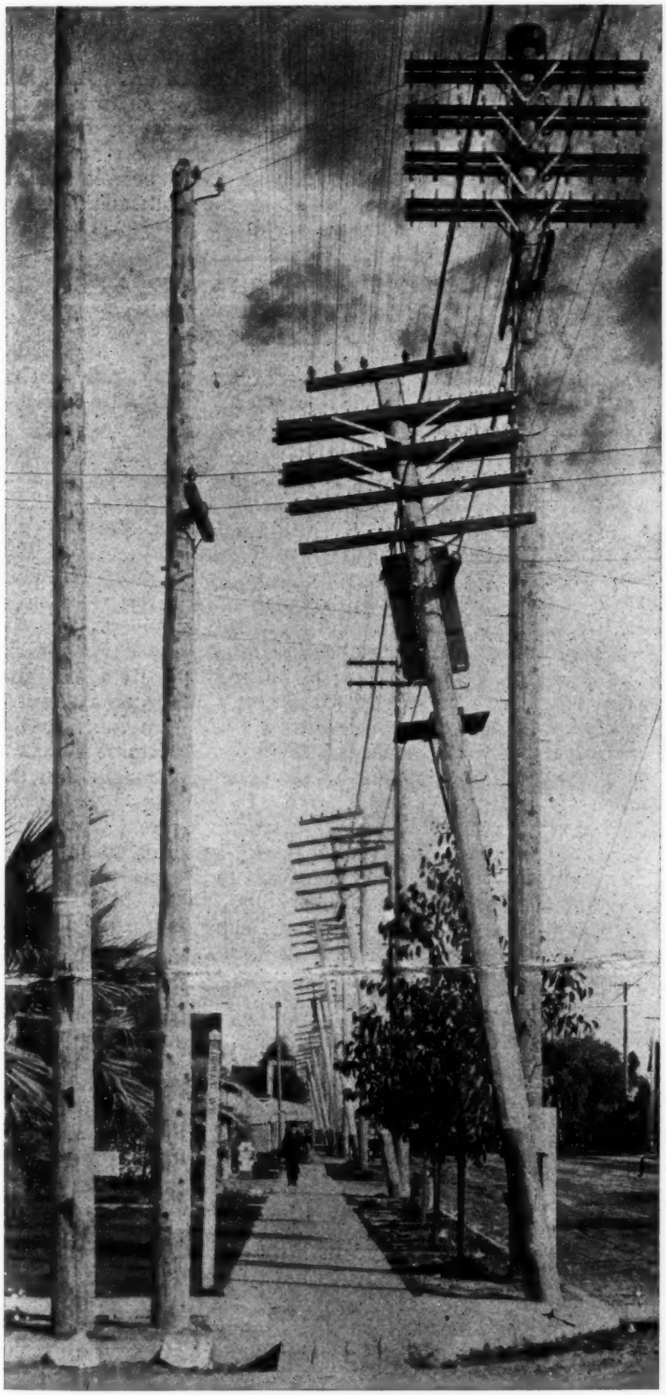


FIG. 1—POLE-TOP TERMINAL.

while the latter is the most expensive at first, there is a saving in maintenance. No rule for this can be given, and it will be necessary to consider the pros and cons of each case.

The number of the ducts and their arrangement will depend on the distribution, but it is usual to consider them in pairs, and as being divided equally on each side of the manhole, e. g., three layers of four each. Wherever possible the ducts should enter the manhole opposite each other, so that, in rodding, the rods may be passed on, thus saving time. The cables can also be arranged to better advantage by such a method. For draining purposes a grade of from 4 to 5 inches in each 100 feet is allowed, and all ducts laid in a straight line, avoiding curves and bends, so as to offer the minimum resistance to the cable on its being pulled in. Sections are usually 500 feet apart, but this rule may be varied to meet special conditions, including lengths of cables, so as to permit all splicing to be done in manholes with the least amount of waste possible. The cement used is generally made of 3 parts sand, 5 parts gravel and 1 part good cement.

Manholes.—Seldom, in any system, are two manholes alike, varying, as they do, in shape and size, according to location and the capacity desired. They are usually built of brick, the bottom being covered with a layer of cement one-half inch thick and having in the center a drain pipe leading down to gravel or to a sewer, the former preferred. The top is covered with an iron lid, permitting a man to pass into the hanhole for repairs, etc. (Fig. 4). The depth is usually about 6 feet and the width 4 feet.

The ducts entering should be so finished off as to set them slightly back from the side of the manhole wall, and

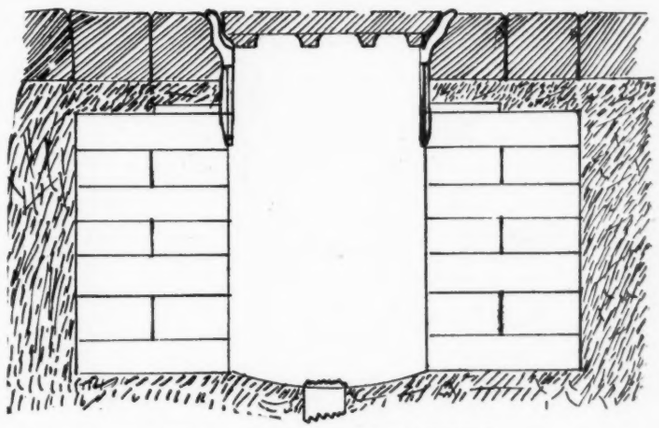


FIG. 4—SECTION OF MANHOLE.

rounded off to avoid damage to the lead sheath of cables. Brackets or supports are fastened to the walls to support the cables, and all splices made at a convenient point for examination or future repairs. It is customary to place lead pads between the sheath and the support, or felt may be used. All iron used should be thoroughly painted to avoid rust.

Cable.—The cable used in underground work is generally made in the following sizes: 50 pair, 100 pair, 150 pair, 350 pair, 400 pair.

The 300-pair size is quite popular, and permits of a flexible distribution for mains, while the 50 to 150 pair are much used for branch cables. The wire used is No. 19 or No. 22, the former being preferred. The wire is copper 98 per cent pure, insulated with one or two layers of paper laid up in reversed layers, pairs being twisted once in every three inches. The insulation is 500 megohms per mile and the capacity .080 M. F. The whole is enclosed in a lead sheath, 3-32 inches thick, of pure lead alloyed with 3 per cent tin and furnished under guaranty free from cracks, holes and other defects.

Drawing in Cable. Various devices are in use for drawing in cables, the most recent being some form of capstan driven by means of electric or other power and so under control of one man as to enable him to regulate the pull at will. Such a machine can easily be put together at small cost and operated by some source of power, such as gaso-

line, enabling it to be used anywhere desired. Fastened to a drum on such a machine is arranged a three-eighth-inch steel rope made up with a soft core. This in turn is fastened to the cable in the same manner as described in the aerial cable. At the distant manhole, the cable reel is so mounted and arranged as to permit the greatest amount of freedom of movement, the cable being passed into the manhole from the top of the reel. Prior to passing in the steel rope, the ducts are rodded in the usual manner. The old method of pulling in by hand is out of date and too slow for modern telephone practice. The greatest care should be taken in pulling in the cable not to damage the sheath, and once set in motion should not be stopped unless absolutely necessary. It will be found necessary to apply grease occasionally to the sheath of the cable to make it pull easily. The rods are four feet long and three quarters of an inch thick, of hickory wood with metal tips. Sometimes ordinary gas pipe or an iron rod is used. If any obstruction is found in rodding, the distance to the trouble can be measured by the rods and the street opened and repairs made.

All ducts are numbered looking away from the head office and a record kept showing their location. The numbering is done reading from left to right and from 1 up, looking in the direction of the cable route.

Each cable should have a separate duct. Where the cables leave the ducts they should be protected with lead cushions.

Splicing. The manner of making splices in underground

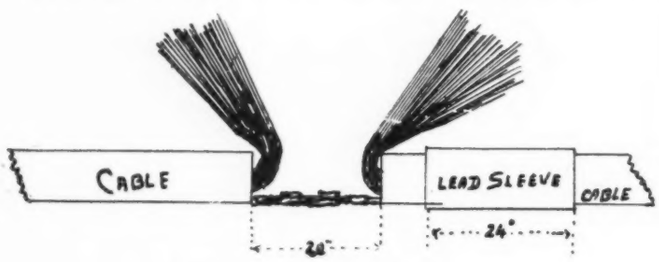


FIG. 5—SPLICING OF CABLE.

work is similar to that in aerial; all splices are made in manholes. In splicing the lead is stripped off about a foot on each end, and the wrapping which is around the outside paper core is taken off and used to bind in the core at the lead sheath end, so as to make it tight. The lead sleeve is then passed over one end (Fig. 5) and the splicing begun. The paper being taken off the ends about two inches, a paper sleeve 3 in. long is passed over one of them, the copper ends are tightly twisted together and folded back, making a good, tight joint, and the paper sleeve is then passed over the joint. This process is repeated, breaking joints so as to scatter them all over the splice, until all the wires are spliced. No soldering is permissible. The splice is usually 22 inches long. It is important for testing purposes, etc., to splice wires of the same color together. The splice being completed, the whole is boiled out by means of very hot paraffin and then the lead sleeve passed over it and closed, water tight, with a plumber's wipe, at both ends. If any moisture is present it will be noticeable during the boiling out process by the presence of bubbles. No splice should be left exposed over night or during moist or rainy weather, as the paper is very absorbent.

Pothead Terminals.—These are of two kinds—those for central office use and those for cable outside terminals. Those for central offices are usually made of silk and cotton No. 22 annunicator wire and spliced to the paper in the usual way, the other end being wrapped with tape and painted with two coats of waterproof paint, and then laced to fit the form required. The potheads for outdoor work are made as follows: A lead sleeve 20 to 36 inches long, according to size of cable, having an inside diameter of 2 to 3 inches, forms the head. This is slipped over the cable proper and okonite wires of same size as cable are spliced to the cable wires, being twisted in pairs and of the same color, or sometimes red and black. These are spliced in the usual manner, using paper sleeves. After all the wires are spliced, the sleeve is brought into place and a wiped joint closes the lower end so as to prevent the compound running out. Prior to this all the wires are tied together loosely with twine. The P. & B. compound is then poured in, filling it completely, and allowed to settle. The compound should be very hot, so as to run easily and smoothly, and the sleeve should be filled to three-quarters inch from the top, keeping the bunch of wires in the center. It should be left twelve hours to set. The okonite wires forming the pothead on being placed in the cable box are laced to hold them in position. It is sometimes customary to place in the sleeve a one-half-inch brass tube so as to permit the air to escape and avoid air bubbles in the pothead; but the writer has not found this necessary.

THE NEW TELEPHONE EXCHANGE AT JACKSONVILLE.

The Jacksonville (Ill.) Telephone Company, one of that city's largest public enterprises, was among the heaviest losers in the fire of 1901, and the stockholders have had a grim fight against the monopoly to get the system running smoothly again. It costs a great deal of money to install a telephone plant of any proportions, and still more to build it the second time. This is what the home company has done, and that, too, without the aid of outside capital. The new exchange will occupy four large rooms on the second story of the building. The large and commodious room in the front is the operating room, and contains the switchboard, chief operator's desk and cross-connection rack. The board is so located that by the removal of a partition extra room may be secured to permit the addition of extra sections when occasion demands. The room next to the operating room will be used as the general office of the company, and will be occupied by the general manager and the secretary.

Just in the rear of this is the inspector's room, which also contains the power plant, panel board, batteries, motors, etc. The switchboard itself was manufactured especially for the Jacksonville Telephone Company by the L. M. Ericsson Company of Stockholm, Sweden, being imported and installed by the Ericsson Telephone Company of New York.

The present board is of a capacity of 1,200 lines, but additional sections can be added when needed until the ultimate capacity of 3,000 is reached.

The multiple board contains eight operating positions, each operator being able to call any subscriber without the aid of other operators.

The incoming call causes a little white tube or shutter to protrude from the surface of the board, and this remains out until the operator inserts the answering plug. The ringing and answering is effected by the use of but one key, which greatly assists the operator to give quick service. The new board is equipped with the breastplate transmitter, thus enabling each operator to have the mouthpiece directly before her at all times.

The cross-connection rack is equipped with a perfect system of lightning arresters and heat coils, protecting the board from being damaged by lightning and power currents. Also, the wires in the switchboard have a wool insulation, thus preventing the starting of a fire, should any wire by accident become overheated.

The work of installation is being superintended by Mr. Charles E. Monroe, electrical engineer of the Ericsson Telephone Company, assisted by Mr. J. B. Wilkinson, Jr., Southern representative of the same company.

DIGEST OF TELEPHONE AND KINDRED PATENTS

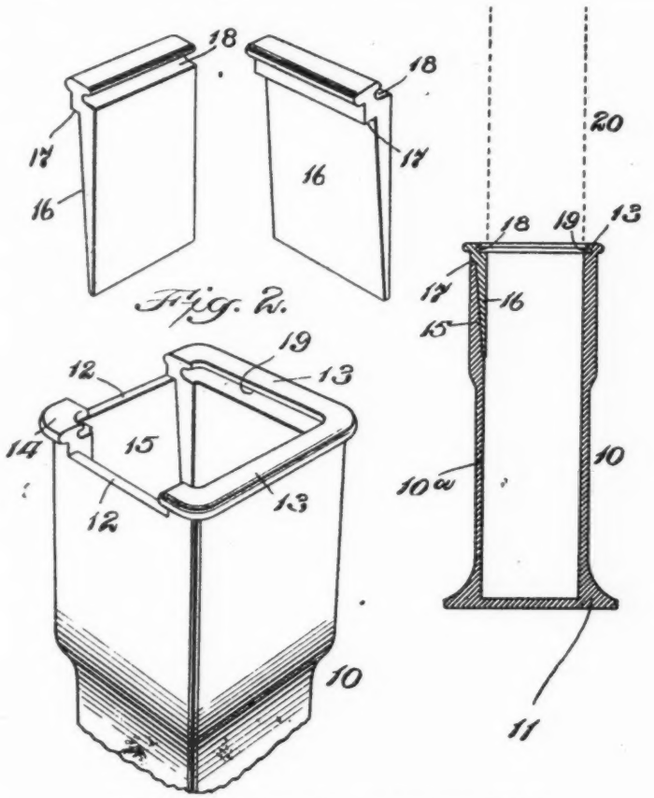
Conducted by EDWARD E. CLEMENT.

MARCH 17.

722,663—C. H. Baker, socket for telegraph poles.

This is a holder or socket intended to be sunk in the ground to receive the base or lower end of a post and is provided with means to enable a post to be readily inserted, although shaped to be a close fit, and also to keep out water.

The socket consists of a body casting 10, having an enlarged foot 11, to give a firm foundation, and inner faces

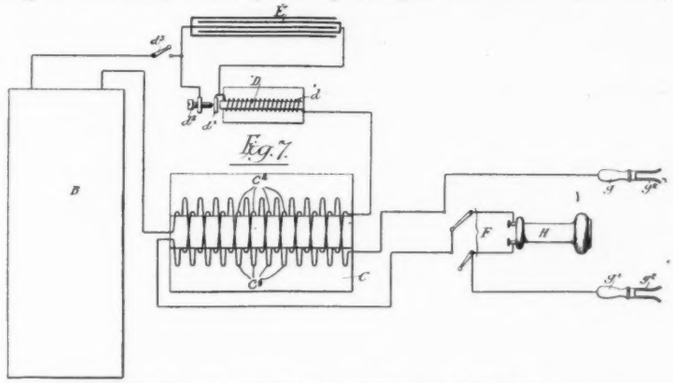


722,663—SOCKET FOR TELEGRAPH POLES.

inclined to two of its side walls at their upper ends, as shown at 15. The pole 20 is inserted in the socket after the latter is set in the ground, its insertion being facilitated by the inclined faces 15, and thereafter the wedges 16 are inserted and a packing material forced into the groove 18-19, which extends all around the inner edge of the upper ends of socket and wedges. The wedges jam the pole into place and the packing prevents the access of water.

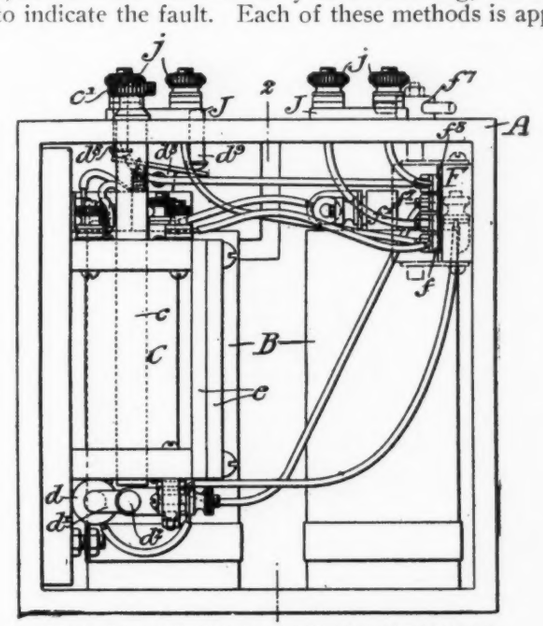
723,205—H. A. Lewis, electrical testing apparatus.

This apparatus is intended as a substitute for the hand generator set which is ordinarily used to "ring out" circuits. According to the old way, in testing, for instance, to find a damaged coil on an armature, such as one that was grounded on the shaft, the coils would all be rung through from commutator to shaft, and this general method is not departed from in the present case. Mr. Lewis provides a buzzer with a pair of dry cells connected with the primary of an induction coil having an adjustable core, the secondary being connected through suitable switches to a telephone receiver and to a pair of testing terminals. In the diagram, B is the battery, D is the buzzer, having its vibrating terminals d^1, d^2 shunted by the condenser E in the usual manner to prevent sparking, and C is the induction coil. The battery and buzzer are in a local with the primary winding c^2 of the coil, this local having a switch d^3, whereby it may be opened at will. The sec-



723,205—ELECTRICAL TESTING APPARATUS.

ondary c^3 is connected to the test terminals g^2, having suitable handles g-g^1, and the telephone receiver H is connected through switch F so that it may either be placed in series with these test terminals, as shown in the diagram, or, by throwing up both the blades of switch F, the receiver may be bridged across the terminals. In the former case, when the terminals are being moved about in testing, the secondary circuit will be closed through the receiver when the ground is found, and a loud humming noise will be heard. In the second case the secondary will be normally closed through the receiver and the latter will be shunted when the fault is found, hence there will ordinarily be a humming, which will stop to indicate the fault. Each of these methods is applica-



723,205—ELECTRICAL TESTING APPARATUS.

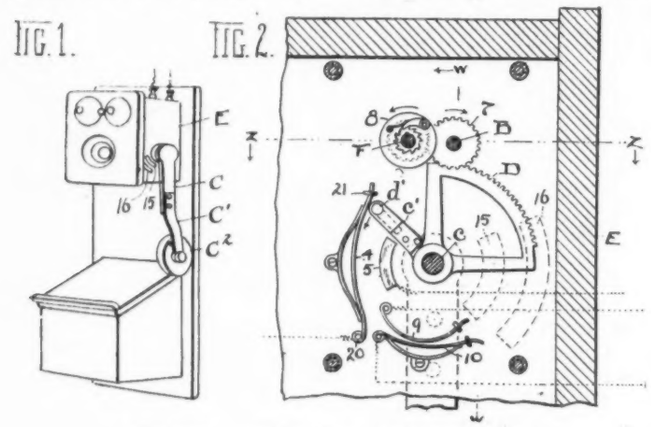
ble to particular cases. Thus where there are considerable differences of resistance between the normal and abnormal conditions, the direct series may be used to advantage, because the induced current will be kept back by the high resistance and let through by the low. Where the differences

of resistance to be tested are comparatively small, however, the shunt method is preferable, because even slight differences in resistance will produce noticeable variations in the receiver. Mr. Lewis says he makes all his windings, including the receiver winding, low. The adjustability of the core of the induction coil C enables the current effects in the secondary to be easily regulated. The entire set is inclosed in a compact case, as shown in the smaller figure, and the switch F is made rotary for ease of adjustment.

MARCH 24.

723,309—J. P. Riedinger, telephone attachment.

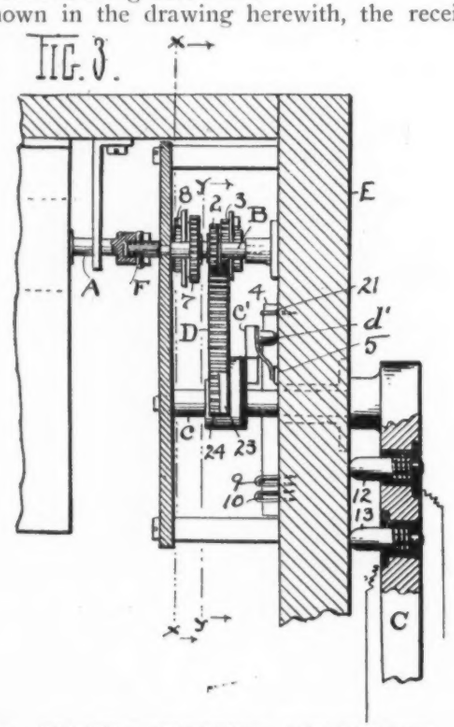
This is a mechanical movement interposed between the receiver and the magneto generator of a telephone, set so that when the receiver is taken up for use the generator is operated to send a signaling current, and the talking circuits



723,309—TELEPHONE ATTACHMENT.

are completed, while when the receiver is relinquished after using, the generator is again actuated to send a clearing-out signal and the proper changes are again made in the circuit, all these actions being automatic.

As shown in the drawing herewith, the receiver C^2 is



723,309—TELEPHONE ATTACHMENT.

mounted on a spring metal arm C^1 carried by a crank arm C on a shaft *c*. This shaft carries a toothed segment D, which engages with two gears 2 and 3, on separate shafts B-F. These shafts also carry gears 7 and 8, which intermesh. The gears 3 and 8 are loosely carried on the shaft F, and have pawls on their faces working in opposite directions, in rachets rigidly fixed to the shafts. This shaft F is coupled directly to the generator shaft A, as shown in Fig. 3. As a result of this construction, when the receiver is lifted up the shaft *c* is turned, the segment D turns the gear 3 and thereby the generator shaft forwardly, while it turns the gear 2, and through it the gears 7 and 8 idly, the pawl of 8 riding backward over its rachet. Thus a signaling impulse is sent into central. When the receiver is turned down, after using, into the position of Fig. 1, the segment D turns the gears 2 and 3 in reverse direction from the first, and hence gear 8 turns the generator shaft forwardly, while gear 3 turns backward idly.

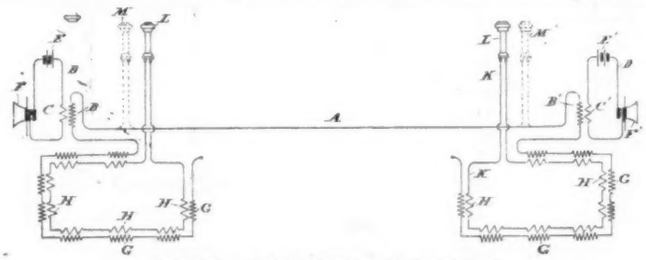
Contacts 12 and 13 on the receiver arm C slide on and off of said metal contacts 15-16 on the box, and other contacts 4-5 are completed through the arm c^1 d^1 during the movements of the receiver arm to make and break the talking and generator circuits in proper sequence.

12,103—Reissue, Chas. B. Burke, telephonic apparatus.

This is a reissue of letters patent No. 719,432, Feb. 3, 1903.

Mr. Burke states that the invention consists primarily in a novel receiving apparatus, but it also includes the combination of such apparatus with a line circuit composed of a single conductor which is not grounded at either end, "having discovered that under these conditions I am enabled to transmit with perfect distinctness articulate speech."

Stated in general terms, the receiving apparatus comprises two magneto receivers arranged in a convenient manner so that in use one instrument may be held to each ear. One receiver is in the line circuit, or connected with the single con-



12,103—TELEPHONE APPARATUS.

ductor of the same, while the other is in a local circuit maintained in inductive relation to the line by means of a plurality of induction coils, the fine-wire secondaries of these being in line and the coarse-wire primaries in the local circuit. With such a receiving apparatus Mr. Burke says that results of a novel and remarkable character may be obtained, and that it is possible to transmit over an open circuit—that is to say, a single conductor—which is not grounded at either end.

In the figure, A is the line, containing the secondary windings G, the primaries of which, H, are in a local circuit containing receiver L, a twin receiver M being included in the line.

723,694—G. A. Long, telephone toll register.

This is a toll register worked by a key at the subscriber's station and giving an audible signal to the listening operator at central. The working parts of the mechanism are all mounted on a face plate *a*, and are very simple. The register proper is shown at *e* and consists of an inclosed set of indicating gears having a central shaft carrying a star wheel *f* adapted to be engaged by the finger g^1 of the key tumbler g, when the latter is rotated by the key at the request of the operator. The audible signal is given by means of a gong h mounted on a boss h^1. This is struck by a hammer *i* pivoted immediately of its length and having its head pulled over against the stem of the gong by the spring 1. On the other side of the gong from the hammer is a damper *k* on an arm

k^1, this serving to prevent the sounding of the gong by striking or jarring the box. The ends of both the hammer and the damper extend into proximity of the tumbler *g*, and the same springs 1 serve both to draw them toward each other and the gong.

In operation, when a call has been made and the connection obtained, by the operator's request the subscriber in-

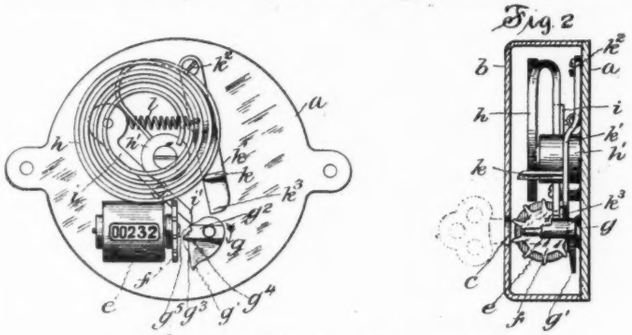


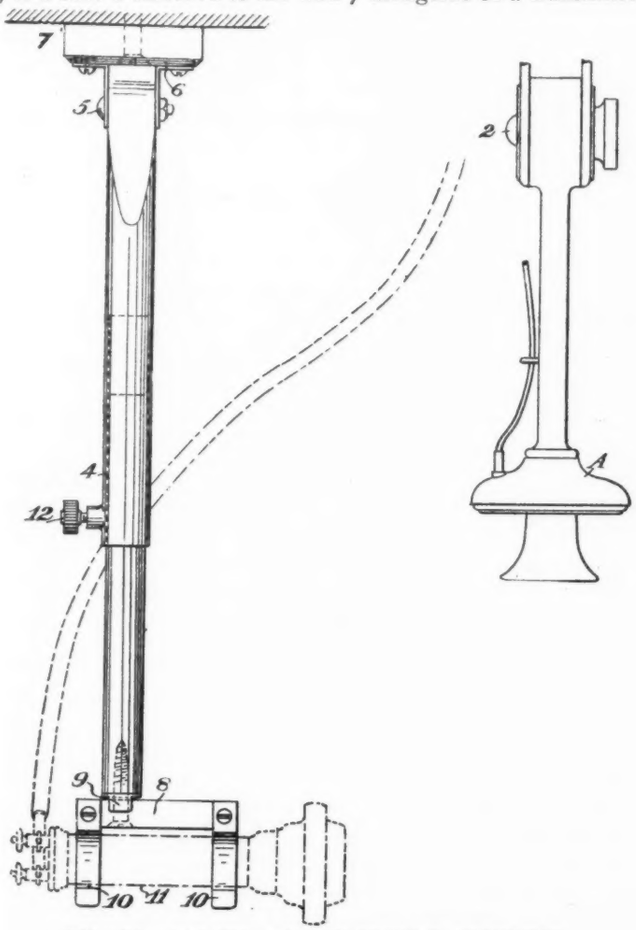
Fig. 2

723,694—TELEPHONE TOLL REGISTER.

serts his key and turns the tumbler *g*, whereupon the finger g^1 first rotates the star wheel, then the damper is raised and the hammer drawn back and permitted to give its blow upon the gong. Reverse movement of the tumbler is prevented by the engagement of notch g^3 and shoulder g^4 with the hammer or the damper.

723,471—S. Konigstein, holder for telephone receivers.

This is a receiver holder consisting of an arm 4 pivoted at 5 to a base 6 fastened to the wall 7 alongside of a transmitter



723,471—HOLDER FOR TELEPHONE RECEIVERS.

arm base 2 carrying a transmitter A. Telescoped in the arm 4 is an extension arm adjustably held by set-screw 12, and carrying at its outer extremity a cradle 8-10-10, in which the receiver 11 is adapted to be laid and held against the ear. The cradle is pivoted by means of a screw shown in dotted lines on the end of the arm, and its motion is limited to stop plugs 9.

723,635—F. J. Becker, adjustable support for telephone receivers.

This is another receiver support adapted to be mounted on the base 6 alongside the transmitter. This base has bracket arms 9, between which is pivoted the bracket 11, having on its end a disk bearing for a rotary carrier 13, in which are grooves supporting the bent-wire extension arm 12, at the outer end of which is a pivoted cradle carrying the receiver 15.

Thus far the construction is simple, being merely that of a pivoted extension bracket; but Mr. Becker has added means to automatically control the telephone hook. The bracket 11 is kept swung toward the transmitter 21, by the spiral springs 19, and carries upon it a pivoted trigger or bell crank 22, kept in position, as shown in figure 21, by a spring 27. Pivoted on the base 6 is another bell crank 24, having one end turned down in the path of the trigger 22 and the other extending out past the bracket, as shown in figure 2, to a point underneath the switch hook 26, with which it is connected by the adjustable rod 25. When the receiver 15 has the ear pressed against it the whole arm 11-12 gives back, turning on the pivot and turning the trigger 22 away from the downwardly extending finger 24;

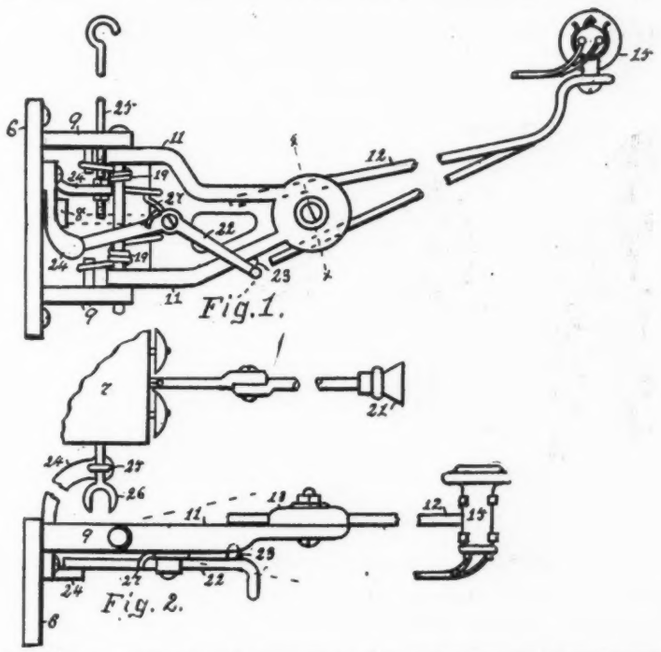


Fig. 1.

Fig. 2.

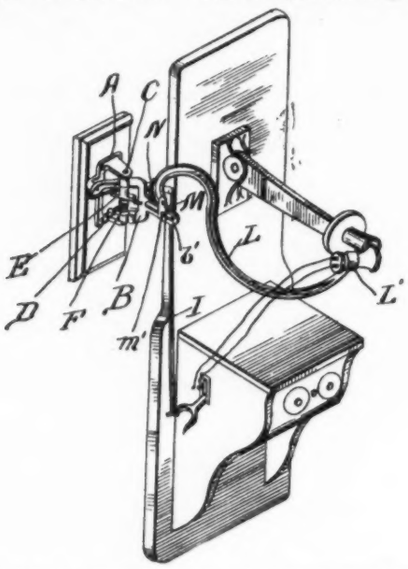
723,635—ADJUSTABLE SUPPORT FOR TELEPHONE RECEIVERS.

whereupon the switch hook immediately rises, raising the lever 24 with it. When the ear is taken away from the receiver the springs 19 throw the arm 11-12 around toward the transmitter 21, as shown in figure 2, and the trigger 22 is then turned so as to push over the lower end of bell crank 24, and pull down its upper end, together with the switch hook.

723,742—D. W. Shiek, telephone receiver support.

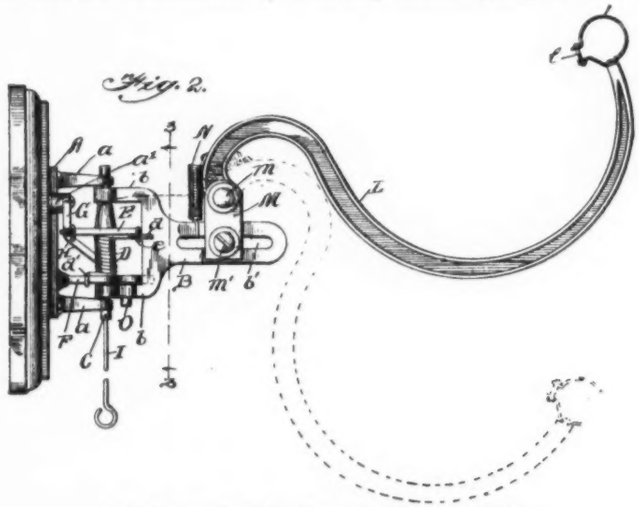
Telephone receiver supports seem to be gaining in popularity with the inventors if not with the public. The present invention is on very similar lines to those adopted by Mr. Becker, whose ingenious product is described above. Mr. Shiek is a little more "up to date," as he shows his holder attached to a common-battery wall set. On the base A are

projecting bracket arms *a-a*, between which is pivoted the arm B, carrying a pivoted extension L, which supports the receiver upon its end at L'. This extension L is held up by a



723,742—TELEPHONE RECEIVER SUPPORT.

spring N, but it can be turned down to suit a person of any height, and can be adjusted back and forth by means of the slot *b'*. The compound arm B-L is normally thrown over toward the transmitter by a strong coiled spring D, and a



723,742—TELEPHONE RECEIVER SUPPORT.

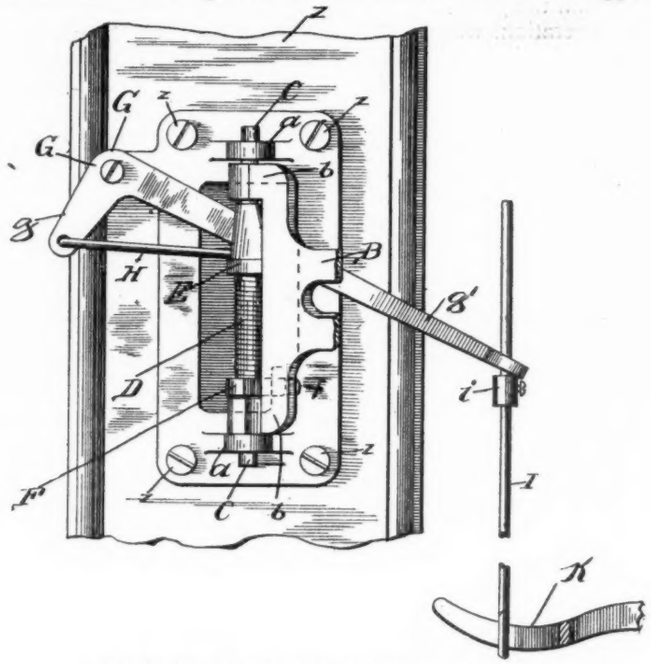
disc E, which is mounted on the pivot with the spring, and connected through a bell crank lever G and links H and I with the switch hook K, as best shown in Figure 4, throws over the lower arm *g* of the bell crank and thereby throws down the switch hook, overcoming its spring.

When the ear is placed against the receiver the arm B-L is moved to the left, the link H pulls the bell crank lever arm *g* to the right, lifts the long arm *g'* and the link I with its adjustable stops *i*, and permits the hook to rise.

723,717—J. D. Nicholson, electric conductor.

If the drawing in this case does not tell the story, the claim will. It is as follows: "A compound electrical conductor composed of a core and a shell of different metals drawn into wire, one metal being aluminum and the other copper."

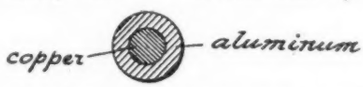
This application was signed at Belfast, Ireland, right after the 4th of July. The patent belongs to the Pittsburg Reduction Co. The combination looks like good luck. Mr. Nicholson says that he has found it possible to make a wire drawn or moulded from a compound ingot made of the two metals. One way is to cast the core of copper, it having the higher melting point, then while this is at or near the melting point of aluminum casting the shell of the latter around the copper



723,742—TELEPHONE RECEIVER SUPPORT.

core; or this operation may be reversed; or again the ingots may be formed separately and consolidated by hydraulic pressure. In any case, the metals must be kept separate to get the full benefit of the combination.

Mr. Nicholson gives the following table of pertinent physical characteristics, and it is obvious that by duly propor-



723,717—COPPER AND ALUMINUM CONDUCTOR.

tioning the two metals the resultant strength, conductivity, sectional area, or weight, may be brought to any desired standard.

	Aluminum.	Copper.
Specific gravity	2.68	8.93
Relative specific gravity	1	3.33
Relative electric conductivity	61	98
Tensile strength per square inch	24,000 to 55,000 lbs.	30,000 to 60,000 lbs.
Relative sectional area for same electric conductivity	159	100
Relative weight for same electric conductivity	47.77	100

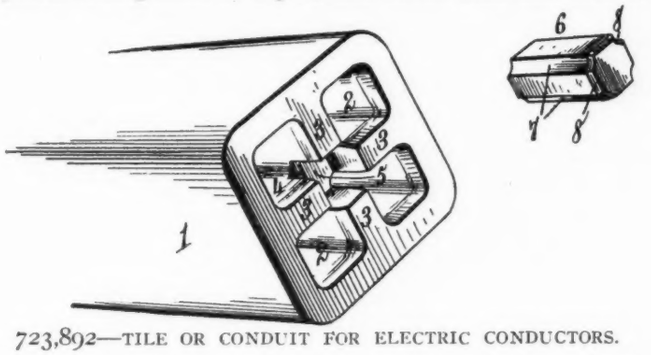
MARCH 31.

723,892—R. W. Lyle, tile or conduit for electric conductor.

This invention contemplates the aligning of successive sections of cable conduit by means of permanent dowels instead of the removable rods heretofore employed. As shown in the figure, the central part of the dividing web is bored out with a tool on which separate application for patent is stated to have been filed, the opening of the bore into the ducts at 4 facilitating the passing out of chips that might otherwise obstruct the operation of the dowels. The dowel 6 has its ends chamfered as at 8, and its edges grooved as at 7, so that no sharp edges are presented to the cable when inserted. The singular shape of dowel and socket prevents lateral or axial displacement, keeping the sections aligned in every direction.

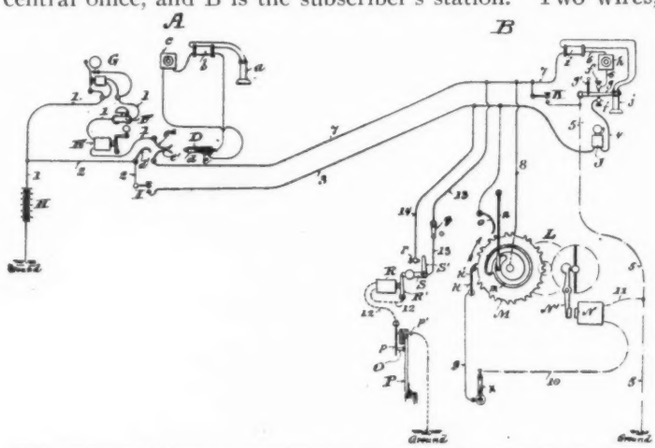
724,093—B. O. Fox, combined telephone, signal, burglar and fire alarm.

It is somewhat difficult to determine just where any niche can be found in the scheme of modern development for this specific arrangement of a grounded circuit with thermostats,



723,892—TILE OR CONDUIT FOR ELECTRIC CONDUCTORS.

keys and alarm bells. The idea is that a telephone circuit shall serve also to give signals in case of fire or invasion by burglars, or in response to special need calls from a subscriber who presumably cannot speak his wants. A is the central office, and B is the subscriber's station. Two wires,



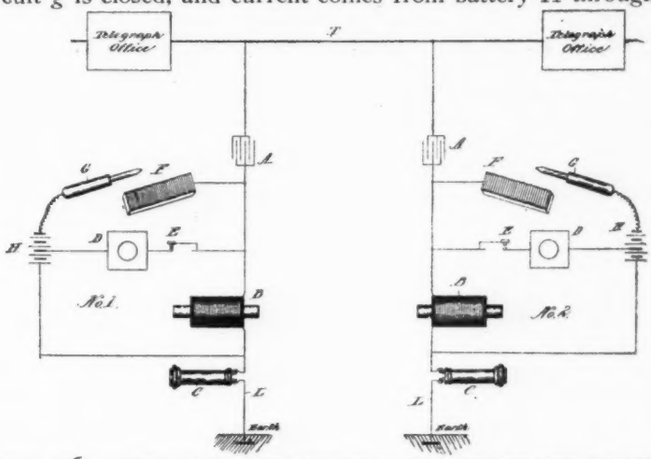
724,093—COMBINED TELEPHONE, SIGNAL, BURGLAR AND FIRE ALARM.

7 and 8, are provided, but they are not used as a metallic circuit for talking, but only as separate signalling circuits.

At the subscriber's station a telephone set having transmitter *h*, receiver *j*, induction coil *i*. switchhook *g*, and ringer or bell J, is provided. The hook is connected to ground by wire 5, and to the anvil of key K. In talking the hook goes up, and completes a circuit from ground through the hook, by wire 6 to the transmitter, to the coil and line wire 7, to central, to jack spring *e'*, to sleeve *e* of plug, to the operator's set *a-b-c*, to tip of plug, to spring *d'*, wire 2 to battery H and so to ground. In signalling, the subscriber presses button K, and closes a circuit from ground through the key, by wire 7 to central, through springs *e' e2*, to magnet E, which drops its annunciator, to bell F, which gives a single stroke, and to bell G, which vibrates and continues to do so as long as the button is depressed, by reason of its shortcircuiting itself every time the armature is pulled up, thence by wire 1 to battery and to ground.

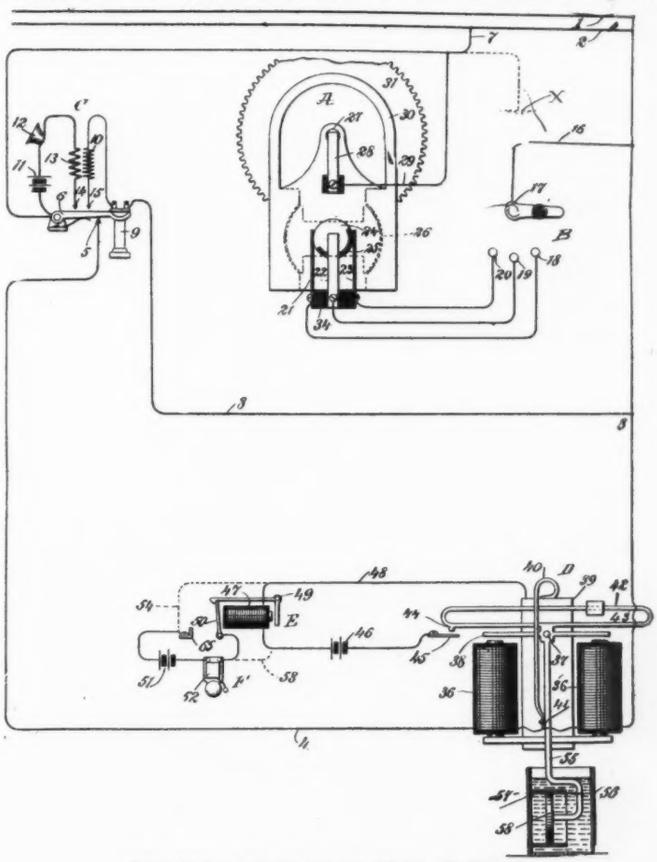
For burglar alarm purposes, a circuit closer O-*p* is provided, shown applied to a door, which normally keeps it open. If the door is tampered with the circuit closer closes, and a circuit is formed from ground through the closer, through magnet R to wire 7 by wire 13, whereupon the results given above follow at central, and the magnet R throws down its drop, closing circuit by wire 14 from wire 7 through wires 13 and 14 to subscriber's bell J and thence to ground through the switchhook, giving also a continuous ringing on subscriber's bell.

A fire alarm box is also provided, having a wheel M normally wound up and held by a detent controlled by magnet N, in circuit with a theromtsatic or thermometer circuit closer *x*. When the temperature rises high enough, the circuit *g* is closed, and current comes from battery H through



724,336—TELEPHONE ATTACHMENT FOR TELEGRAPH LINES.

all the central office apparatus heretofore detailed, operating it all, to the wheel M, spring *k*, thermostat *x*, magnet N and ground, operating the magnet and releasing the train of clockwork, whereby the wheel M is revolved and sends a predetermined number signal by means of the teeth *k'* and the spring *k*. This gives the number at central on the single stroke bell F. When the wheel M has made a complete



724,219—TELEPHONE CALL SYSTEM.

revolution, the cam slot *m* throws spring *n* against contact *o*, and again circuit is closed by wires 7-8 and 3 to the subscriber's bell, which tells him to look out for fire and come wind up his box if he can get to it. The bells, both at central and sub-station, go on ringing merrily until the box is

wound up, so if the house gets full of smoke and no one can get in for a while, there is likely to be a joyous time at central—unless they cut the wire.

724,336—E. Russel, telephone attachment for telegraph lines.

This is an ingenious arrangement for calling and talking over a telegraph or other line, with battery current only, and is particularly intended for use in army field work. Major Russel has designed a number of special sets for the work of the U. S. signal corps, and this apparatus will doubtless be widely used. Each set has a transmitter D, receiver C, and battery H, usually of dry cells, with a circuit closer E for the talking circuit, and the calling device, which consists of a stylus or electrode G and a roughened strip of metal F, the first connected to the battery and the second to line. If the stylus G is drawn over the strip F, a rapid succession of breaks is produced, whereby short and sharp induced impulses or discharge from the coil B are thrown on the line, causing loud and rather strident noises in the receivers at both ends of the line. By then separating the electrode and strip and depressing the button E, conversation can be carried on.

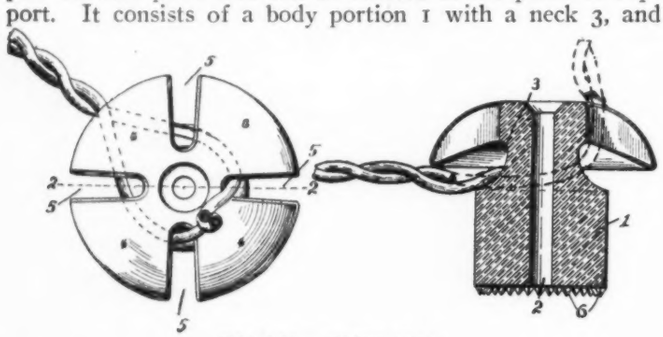
Condensers A-A are interposed in the line connections for the purpose of preventing leakage of the line currents from the telegraph batteries, each complete set, with its condenser, being enclosed in a compact carrying case.

724,219—E. A. Terpening, telephone call system.

This is a selective party line ringing system. One station is shown in the figure. The telephone talking set 9-10-11-12 is of ordinary bridging type, the switchhook cutting in the bell when down, and the telephone when up. The bell or ringer is biased at two stations, and of the ordinary polarized type at a third. Positive currents or negative currents, as the case may be, will tilt the armature 38 against the spring 40, and close the local circuit 48 at contracts 44-45, throwing down the drop 50 and ringing the local bell 52. A dash pot 56 is employed to make the armature action sluggish, so that it will not respond to alternating currents in any case. The generator at each station has the usual spring 28 for return to the shaft and frame, and a commutator 24 on the end of the armature shaft, with positive, negative, and alternating current springs 21, 23 and 22, respectively, resting thereon. The selective switch B enables any desired spring of the set to be connected to line, when the proper current may be sent out. 43 is a balancing weight on the ringer armature, which may be replaced by a ball rolling in the frame 42, so that when the armature is once tilted it will remain so until replaced by reversed current.

724,329—R. H. Polk, insulator.

This is a knob or insulator intended for use with twisted pair or with pairs that can be twisted at the point of support. It consists of a body portion 1 with a neck 3, and



724,339—INSULATOR.

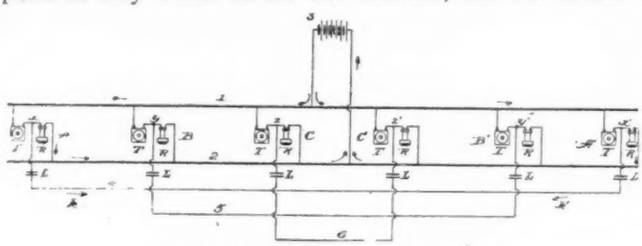
spreading head divided to form separate cleats 4-4-4-4 with spaces 5-5-5-5 between them, in which the wire can be twisted or pass in and out, as shown.

APRIL 7.

724,594—J. H. Mason, telephone system.

This is an intercommunicating telephone system, and the patent is the property of the "Wheatstone Bridge Telephone Company, of Souderton, Pennsylvania, a corporation of South Dakota," which proves that other things besides wheat and divorces can be grown in the great Northwest.

The idea in this case is to produce a common battery system without cross talk, simple in design, and with only two more wires than there are stations. That is, there is one individual wire for each station in the system, and a battery pair, but all talking is over metallic circuits. In Figure 1 a condensed diagram is given, which will illustrate the principle. Here 3 is a secondary or other battery of low internal resistance, bridged across and supplying current to main wires 1-2, which extend to all the stations. All the stations are bridged across these battery wires, with transmitter and receiver at each in series in its branch. These stations are also shown coupled up in pairs as they would be for conversation, and the circuit of



724,594—TELEPHONE SYSTEM.

a single pair will render all clear. Take stations A and A′ at the ends of the line. A single wire 4 extends from a point x between the transmitter and receiver of station A to a similar point x' between the transmitter and receiver at station A′. In this wire are condensers L, L, to keep out stray currents, but not necessary for the operation of the pair. We have here the condition of a balanced wheatstone bridge. Where the battery is connected to each wire 1 or 2, the sides of the bridge commence, each side including a transmitter or receiver of one station A or A′, and the wire 4 is the bridge wire. Now, if one transmitter, T at station A, for instance, changes its resistance, current will flow back and forth through the bridge wire and affect the receivers at both stations. The distribution of battery current to other stations will not be affected, however, hence there will be no cross talk—probably.

To apply this principle to a complete system, with calling, each station is provided with a home wire extending to switch contacts at all the stations, and each station switch is kept normally on its home contact. When any station selects another, it is by switching onto its home wire, and the calling is done in the usual way, over the battery circuit, the bells being battery bells and cut out when the switchhooks go up. In Figure 2 the development is shown. 1 and 2 are the battery wires, as before. 4-5-6-7-8 and 9 are the individual wires, each connected to the same contact in all the selective switches, s-s-s-s-s, etc. When switch at station F, for instance, is placed on the contact of wire 8, and the push button i is depressed, c battery circuit is closed to the bell X at station B. When the hooks go up, the same condition is established between stations Talk goes on in the same way.

The arrangement of this system is ingenious, the instruments are simple, and if in practice there is really no cross talk, due to lack of balance, it should be a good thing.

724,478—C. Holmok, switch mechanism for telephone transmitters.

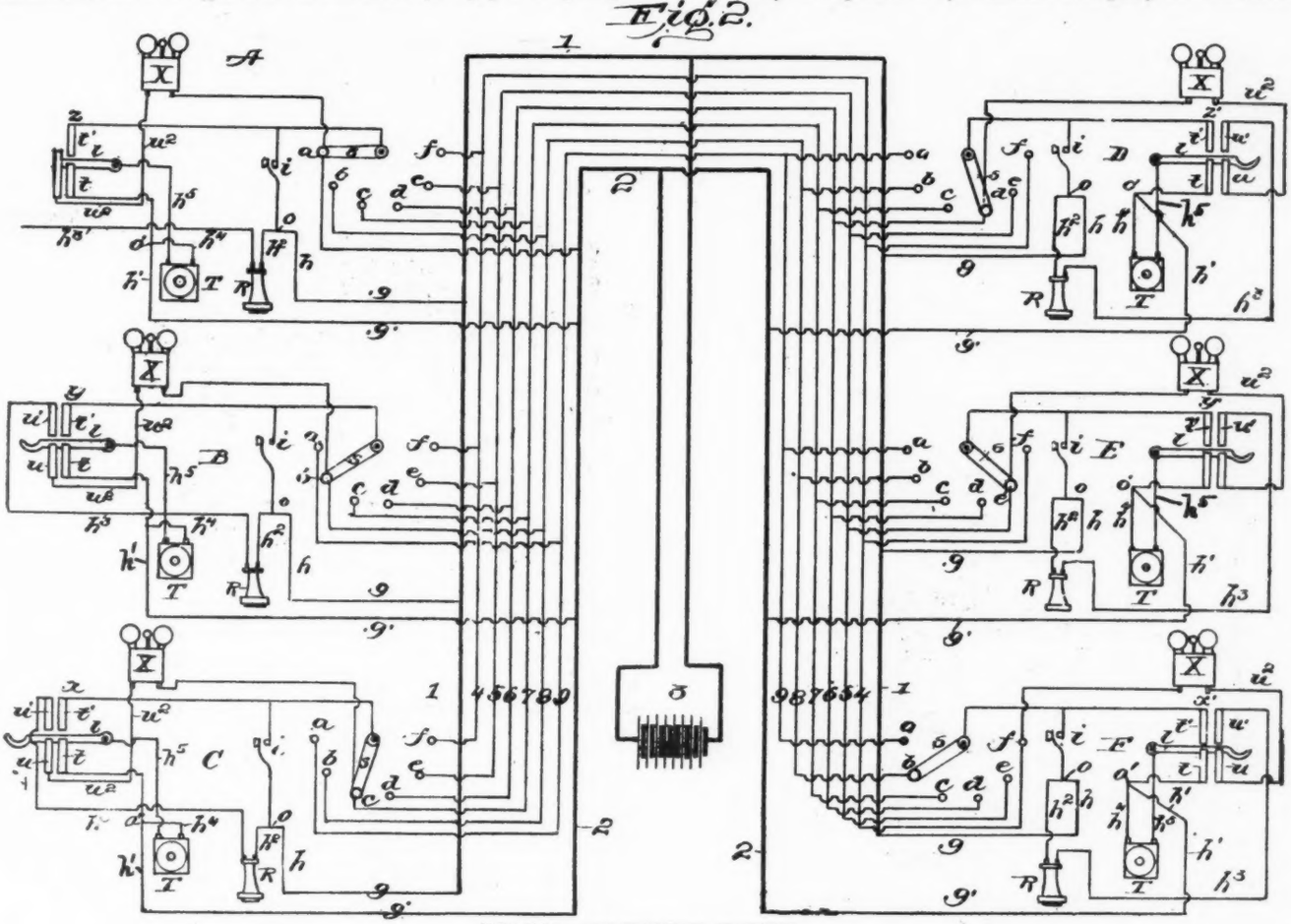
This is a switchhook for desk sets. It is called in the claims a "disconnecting lever for telephone transmitters"! It seems to be intended as an improvement on the well-

known self-contained types of desk sets manufactured by the American, Kellogg and other companies. 2 is a strip of vulcanite or fibre, fitted to a cap 3, and carrying the switchhook lever 6 (pivoted in the fibre!). 9-9 are springs

APRIL 14.

725,244—W. Gray, telephone call register.

This is a pay-station device, and the patent is assigned to the Gray Telephone Pay Station Company of Hartford,

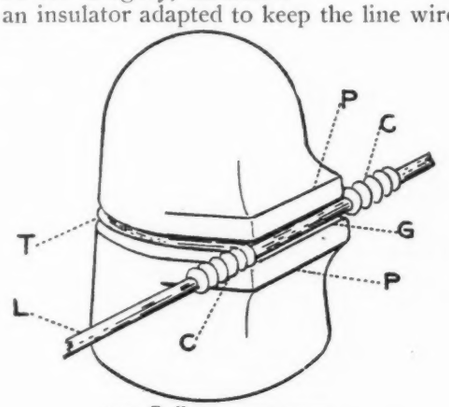


724,594—TELEPHONE SYSTEM.

"of copper or other metal which is a good conductor," fastened to the lever 6 and playing back and forth in slotted posts 11-11, also secured on the fibre. 12-12 are fixed contacts. When the hook is down the springs are up, and when the hook is up the springs are down, and that is all there is to the "invention."

724,848—F. W. Gregory, insulator.

This is an insulator adapted to keep the line wire straight



724,848—INSULATOR.

in tying, and yet tie tight. One face of the insulator is straight, that is a plane, with a straight groove in it for housing the wire, and a circular continuation around the body for the tie wire T. L is the line wire.

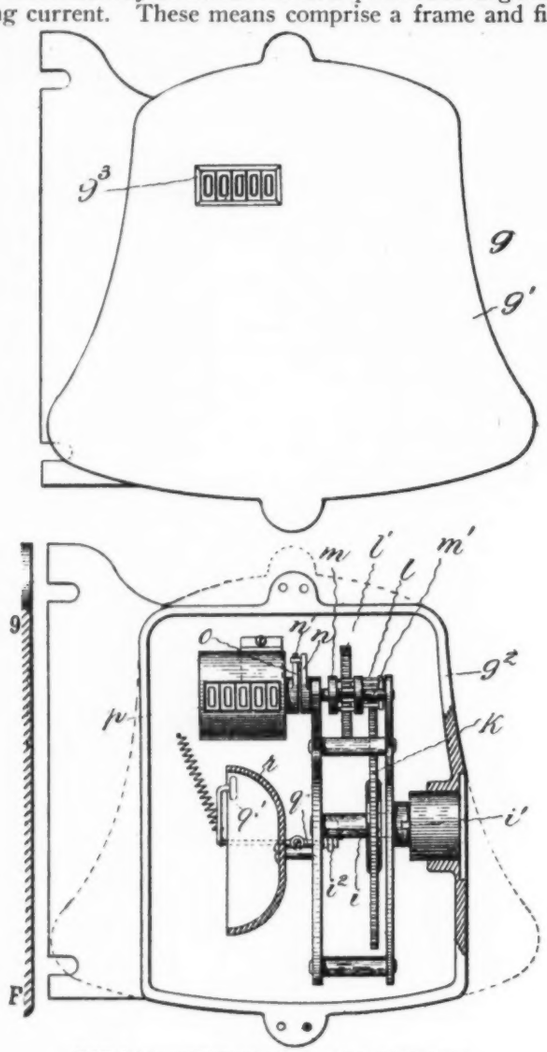
Conn., the concern that makes most of the devices of this character for the Bell subcompanies. Its friends are clearly indicated by the favorite outline of the casing *g*, which is doubtless painted blue when in use.

The invention is a modification of that covered by letters patent No. 654,112, July 17, 1900, to the same person. It consists of a cyclometer register *p*, which counts the number of calls, and indicates the same through an opening in the face of the casing, together with means to operate the same by a key and to ring a bell at the same time. In the figure the key barrel is shown at *i'* the key when inserted turning a shaft or arbor *i*, which turns a gear *k*, which in turn turns the lantern pinion *l*, and this by means of its shaft *m'* and the arm *n* thereon, turns the arm *n'* of the register. On the main shaft *i* is a pinion i^2, which engages a hammer lever *q* in turning, and gives one stroke on the bell *r* for each revolution of the shaft. The full signal to central consists of a whirring noise when the key is first being turned, due to the working of the train of gears, followed by the stroke of the bell. Mr. Gray says: "With these two peculiar signals it will be almost impossible for a user to imitate the signal and deceive the central office." The inquiry immediately occurs, Who has been beating Bell telephones? Whoever it is will have to learn to buzz like a clock train to achieve success in the future.

724,144—E. A. Terpening, attachment for electric generators.

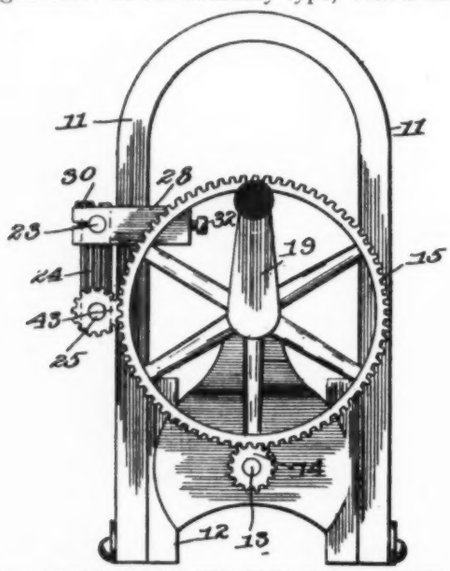
This invention covers means whereby any ordinary mag-

neto machine may be fitted to deliver positive or negative pulsating current. These means comprise a frame and fittings



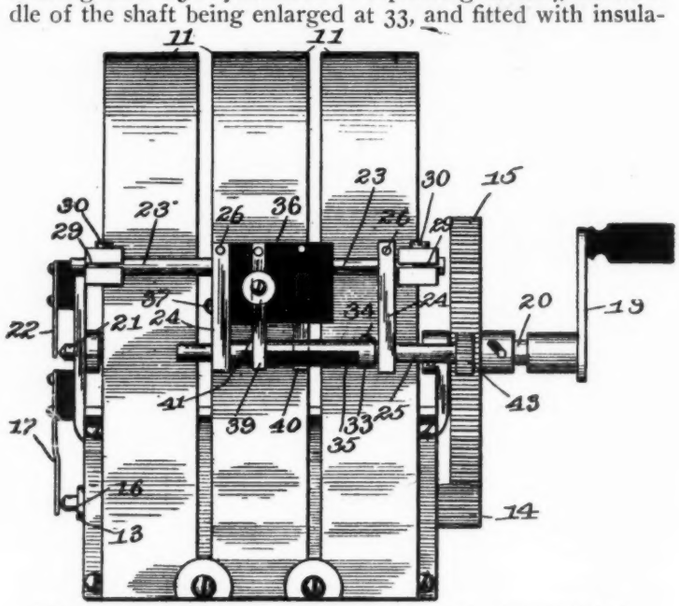
725,244—TELEPHONE CALL REGISTER.

adapted for attachment to the side of the field magnet structure of a generator of the ordinary type, with a commutator



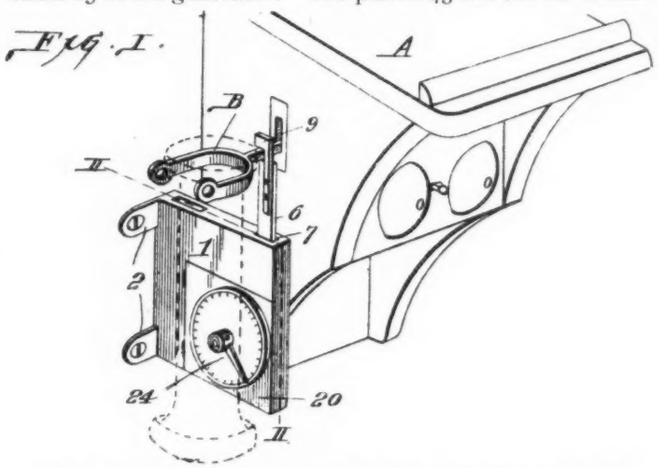
724,144—ATTACHMENT FOR ELECTRICAL GENERATORS.

journalled in the frame and rotated from the main shaft by a toothed gear connection. The frame is supported by a longitudinal member 23 fastened to the field magnets of the generator by screws 32, and carries a block of insulating material 36 with springs 39 and 40. Below the member 23 a rotating shaft 25 is journaled in depending bars 24, the middle of the shaft being enlarged at 33, and fitted with insula-



724,144—ATTACHMENT FOR ELECTRICAL GENERATORS.

tion 35, so that only one of the springs 39 and 40 makes contact at once. The shaft 25 has a pinion 43 on its end, which, when the frame is in position, meshes with the main driving wheel 15 of the generator. The pinion 43 has the same num-



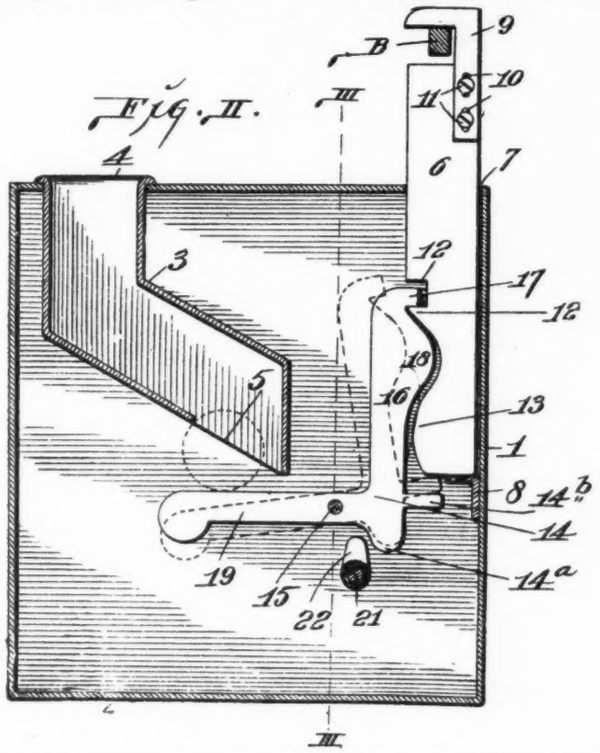
725,339—COIN-ACTUATED LOOK FOR TELEPHONE HOOKS.

ber of teeth as the pinion on the armature shaft, 14, so that the armature and the commutator 33 revolve together. Each half cycle in the armature winding therefore is taken up by one of the springs 39 or 40 and from these springs pulsating current can therefore be taken off. The return for both these springs as well as for alternating current is to the spring 17 on the end of the armature shaft, so no wire connections are required between the commutator springs and the armature, such connection being by way of the frame of the machine.

725,339—J. E. Head, coin-actuated lock for telephone hooks.

This is a lock to be attached on the side of a wall telephone and hold the receiver hook down until a coin is inserted or until a combination tripper is set and the hook is thus released. In Figure 1 the entire device is shown in perspective, the locking slide 6 extending up over the

switchhook B and holding it down. In Fig. 2, the inside of the box is shown with the slide 6 down, and detained by the latch 16, which is in the form of a bell-crank lever, with one arm underlying the lower end and opening in a coin chute 3-4-5, and a projection 14*a* overlying a cam 22 on a shaft extending to the face of the box, where it carries

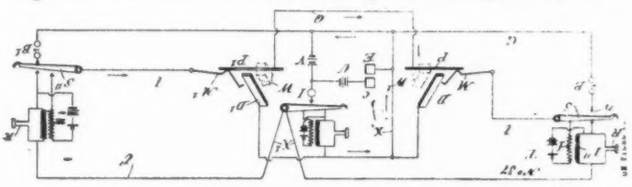


725,339—COIN ACTUATED LOCK FOR TELEPHONE HOOKS.

a hand set on at almost any angle, its principal function being to deceive the uninitiated. By dropping a coin in the slot 4 the lever 16 can be tilted and the hook B released, or by turning the cam shaft 21 and its hand the same result can be achieved. This seems to be not so much a preventive as a deterrent. The dummy dial on the box would not keep many from unlocking the latch without even a slug.

725,476—T. Paul, telephone system.

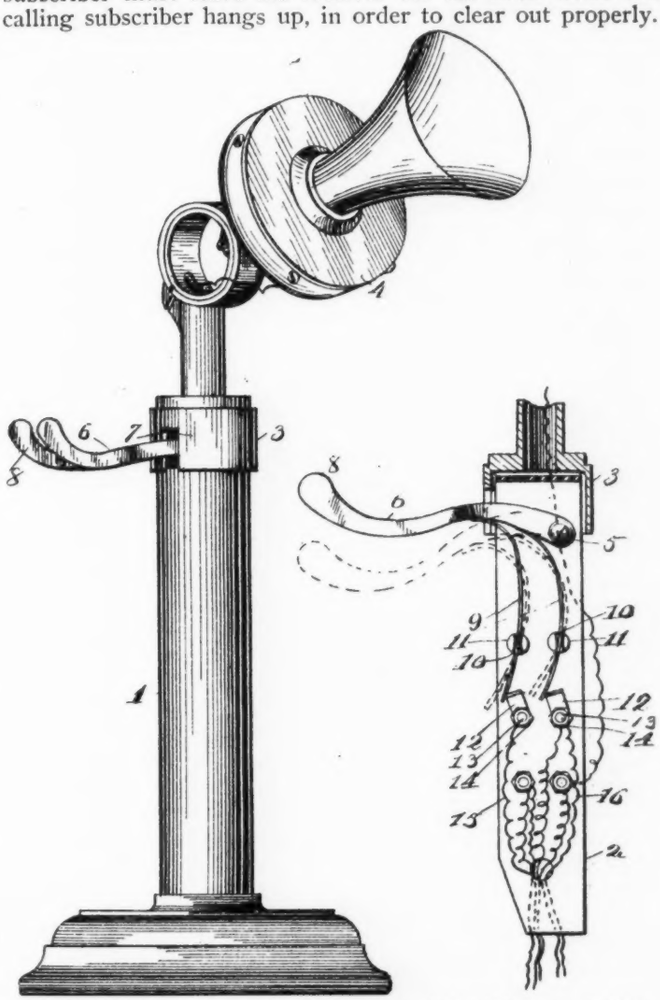
This "invention" may be briefly designated as hash. It is a mixture of McCluer common returns, Law system of calling, old-fashioned grounded ringing, and several other things that no one has ever used, gathered up and put into



725,476—TELEPHONE SYSTEM.

a parcel. A general idea of its merits may be gathered from the statement that all the lines on a section "are normally connected together * * * with the pivoted end of the telephone switch S′ at the central station."

The figure shows two subscribers' stations going through the agony of a connection. The one on the left calls by taking down his receiver. This in some mysterious way works the "signal" I at central. The operator then takes down his receiver from its hook (!) and the subscriber says, "37 on 68." The operator hears this, because his telephone is connected to strips in the switchboard, lettered D, on which the jack line springs M normally rest. He then plugs into jack 37 with plug P, and the trouble commences. Plug P′ is touched to "metal plate" C, and is then carefully drawn over to metal plate E, when the batteries V and U cause the actuation of the signal B′ at the station 67, and that station telephone is finally taken down for conversation, which is over the common return *l′ l′*, and individual wires *l-l*. The operator in the meantime hangs up, or else listens, and if anyone else is being connected, or is connected, they can have the felicity of swearing at each other for talking all at once. However, it is advisable for the operator to hang up and keep out during each connection, for otherwise the clearing-out signal will not work. This is rather ticklish at best, for the called subscriber must leave his receiver off the hook while the calling subscriber hangs up, in order to clear out properly.



724,478—SWITCH MECHANISM FOR TELEPHONE TRANSMITTERS.

The operator is then free to withdraw the plugs. Strictly speaking, this system is absolutely unique, for only one connection at once can be properly made over it. It is to be noted that this is not due to any niggardly spirit or any stinting of materials on the inventor's part, either, for each subscriber has no less than three line wires, although all use the same central office annunciator.

Those who produce wonders are not all dead, after all.

TELEPHONY has my best wishes for an unlimited success in the telephone field. It is worthy of great credit for the good it does in its accuracy in explanations in telephone work, from the most common sort to the most complicated parts, and it should be in the hands of every telephone manager.—W. W. LIBHARDT, Charlotte, Mich.

Decisions Affecting Telephony.

By G. W. HAND.

CHARGES FOR EXPERT OPINION.

The liability that a telephone company incurs in securing professional services is well illustrated by the case of Rosewater v. Glen Telephone Company, decided early last month in the Supreme Court of New York. The city of Johnstown, New York, has an ordinance prodiving that all telephone wires must be placed in subways. The Hudson Telephone Company had been ordered to comply with the ordinance, and to place its wires in the subways of the Glen Telephone Company. The Hudson company brought suit by injunction to restrain the enforcement of the ordinance on the ground that the subways of the Glen Telephone Company which the Hudson was being asked to use were defective. The Glen company, being an interested party, wished to secure evidence that its subways were in good condition, and wrote to Andrew Rosewater, at one time president of the Electric Commission of the District of Columbia, for an affidavit stating his opinion of the subways in question. Mr. Rosewater prepared the affidavit as requested, and forwarded it to the president of the Glen company, together with his bill for five hundred dollars. The president of the company refused to accept either bill or affidavit, and returned them both. Suit was brought by Mr. Rosewater, and recovery obtained on the ground that plaintiff had been duly hired to do a given piece of work, and that owing to his large experience and the fact that he was often sought after for such work, the amount of his charges was not too large. The court also held that the obtaining of the affidavit was within the authority of the president of the Glen company.

Rosewater v. Glen Telephone Company, 80 *N. Y., Supp.* 880.

FAILURE TO PROVIDE REASONABLY SAFE PLACE TO WORK.

The case of Walsh v. New York & Q. C. Railway Company was a suit to obtain damages sustained by an employee while in the service of the company as a lineman. Walsh had been sent out along with several other men to take down some cables from the tops of wooden poles. Preparatory to taking down the cables, he ascended one of the poles and started to saw the wires. After cutting the wires, the pole fell, carrying him to the ground, resulting in injuries to his ankle and back. The decayed condition of the interior of the pole, owing to the paint on the outside and the resulting good state of preservation of the surface, was not easily discernible. The real question before the court was whether the company had provided a reasonably safe place for Walsh to work. The court said that Walsh was not bound to fasten the pole with guy ropes and braces "unless the danger of proceeding otherwise was known and obvious upon a reasonable inspection consistent with a discharge of his duties." The court decided that such "reasonably safe place" had not been provided, and awarded the plaintiff a verdict for three thousand dollars.

Walsh v. New York & Q. C. Railway Co., 80 *N. Y. Supp.,* 767.

IN TEXAS CUTTING "DEAD" WIRES NOT AN INTERFERENCE WITH TRANSMISSION OF MESSAGES.

In a case recently heard by the Court of Civil Appeals of Texas, in which there was an effort on the part of an individual to obtain a reward of one thousand dollars offered by a telephone company of that state for the conviction of any person guilty of cutting poles, tearing down or misplacing its telephone wires, poles or machinery, or unlawfully obstructing the transmission of messages against the provisions of the Penal Code, Article 784, the court was required to pass upon the point whether the reward was intended to cover the cutting of "dead" wires. The terms of the reward plainly were that the interference must be such as obstructed the transmission of messages. At the trial of one Taylor, who was arrested on the charge, it was proved that he was guilty of cutting dead wires belonging to the company, but not any wires that interfered with carrying messages. Priest, a watchman of the company, was instrumental in obtaining the arrest of Taylor, and brought suit to obtain the reward. The company refused to pay the money to Priest on the ground that there had been no interference with the company's property that would make it liable under the terms of the reward offered. In the lower court Priest obtained a verdict, but upon appeal the judgment was reversed.

Southwestern Telegraph and Telephone Company v. Priest et al., 72 S. W. 241.

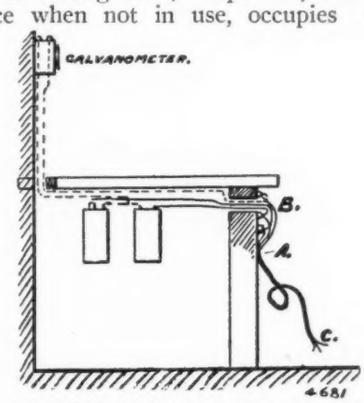
NOTICE A BAR TO RIGHT OF RECOVERY.

In another case tried recently by the New York Supreme Court in which there was an effort made to hold a telephone company liable for the death of a lineman, the court held the accident to have been caused by his own negligence. The suit was brought by deceased's wife as administratrix. Leach, the lineman, was engaged in taking some wires from one pole and attaching them to another pole. The pole from which the wires were to be taken was in a dangerous condition, and was fastened by a guy rope. He was advised not to cut the guy rope until all work on the pole had been finished. He did so, however, and while engaged on work on the pole it fell to the ground and caused his death. No damages were recovered.

Leach v. Central New York Telephone and Telegraph Co., 80 *N. Y. Supp.,* 1037.

A TESTING ARRANGEMENT FOR BELLS AND TELEPHONES.

The accompanying illustration shows a very useful arrangement for testing bells, telephones, etc. It causes no inconvenience when not in use, occupies practically no



A TESTING ARRANGEMENT FOR BELLS AND TELEPHONES.

space, all the connections can be made permanent, and it is always ready for use, says Fielden's Magazine. For the normal position the flexible cord A C hangs in front of

the leg of a bench, where such work is generally done. When it is required for use it is lifted up, and the ends of it afford the necessary connections, as explained below.

A battery is fixed under the bench, and a hole bored in one of the legs. Around this are fixed three terminals, connected as follows:

No. 1. To the galvanometer fixed on the wall.
No. 2. To one pole of the first cell.
No. 3. To opposite pole of second cell.

The other terminal of the galvanometer is connected to the wire that connects the cells in series.

Then attach by a holdfast A one yard of flexible cord. And connect the ends of the three terminals mentioned. Take off some of the covering at the other end C, and leave the ends of unequal lengths, this being done to prevent the ends short circuiting the battery when not in use. The ends may be distinguished by fastening colored threads around them; then the battery end, say the white one, will be the common connection; the red one the galvanometer, and the blue the battery.

By holding the ends one can test with the battery and galvanometer, or the battery alone, as desired.

AN ALLIED TOLL LINE COMPANY.

Representatives from Independent telephone companies in northern Indiana and eastern Illinois met at the Barnett Hotel, Logansport, Ind., on April 14, and organized the Allied Independent Toll Company, which will be incorporated under the laws of Indiana. Walter Uhl, Logansport, was made president and Henry Barnhart, Rochester, secretary.

This meeting was preliminary to one to be held there May 11, when the incorporation will be completed.

It is the intention of those entering the company to perfect a system of toll lines throughout northern Indiana and eastern Illinois to compete with the Bell Telephone Company. A standing committee was appointed to have charge of the work. It consists of C. A. Jay, Kokomo; Dr. Yarling, Peru; Theodore Thorward, South Bend; Walter Uhl, Logansport; Henry Barnhart, Rochester; O. P. Freyberg, Lafayette; T. E. Hanaway, Monticello, and Abraham Halleck, Rensselaer.

Those present at the meeting were: A. Halleck, Rensselaer, and J. F. Bruner, Remington, representing the Halleck Telephone Company; T. E. Hanaway of the Monticello Telephone Company; C. A. Jay and Steve Tudor, Kokomo, Citizens' Telephone Company; Dr. John E. Yarling and Dr. W. A. Huff, Peru Home Telephone Company; R. C. Stephenson and Henry A. Barnhart, Rochester Home Telephone Company; Theodore Thorward, South Bend Home Telephone Company; O. P. Freyberg, Lafayette Telephone Company; O. Rex, North Manchester Telephone Company.

Letters were read from eight other telephone companies of northern Indiana which were not represented at the meeting.

A WISCONSIN MEETING.

A meeting of the local Independent telephone companies surrounding Portage and Columbia county met at Portage, Wis., on April 1, for the purpose of forming an organization to protect and discuss the different interests, and a resolution was passed that W. J. Bell, executive committeeman of the state organization, call a meeting of the different companies at Portage April 14, 1903, to formulate plans to consummate such organization. There were present W. H. Little of the Portage Telephone Co., Mr. Farrington of the People's Telephone Company of Rio, Mr. Smith of the Pardeeville Telephone Company, Mrs. C. A. Colonius of the Central Wisconsin Telephone Company, Wm. J. Bell, committeeman at large of the Wisconsin Independent Telephone Association. The call will be made to have the following companies represented: Portage, Pardeeville, Baraboo, Lodi, Sauk, Prairie du Sac, Poynette, Sun Prairie, People's, Central Wisconsin, Kilbourn and Kingston.

Prominent Exchange Managers

Robert E. Hamblin, general manager of the Toledo Home Telephone Company, is the man to whom, perhaps more than any other, his company owes its recent notable success. Its present prosperous condition is nothing more than those who know Mr. Hamblin and his record have had every reason to expect. Resigning his position as president of the

ROBERT E. HAMBLIN.

Pomeroy National Bank in 1893, he removed to Toledo, where he has been engaged in various enterprises, but has devoted his principal efforts to Inter-Urban Railway interests. In recent years the stock of this company has steadily appreciated until, when the property was sold a year and a half ago, it brought just double its market value at the time Mr. Hamblin assumed charge.

Mr. Hamblin joined the Toledo Home Telephone Company in February, 1902, and although he was at that time without experience in the telephone business, his habit of success continues uninterrupted.

I am a subscriber to TELEPHONY and would not be without it for three times what it costs me.—J. O. LEVEA, Bayard, Iowa.

Telephony.

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THERE MUST BE AMPLE CAPITAL.

One of the more important among the many factors that enter into the problem of maintaining the integrity of an investment in the Independent telephone field, lies in the providing of capital sufficient to make all the extensions that are absolutely essential to maintain the profitable prestige of a telephone plant.

Many telephone companies are now simply proving the truth of the statement made at the telephone conference held in 1889, fourteen years ago, that "the very rapidity with which this industry has developed carries in itself a serious inconvenience." And it was then, fourteen years ago, shown how a company desirous of complying with all the demands for its service and to keep that service up to a high standard, "is often compelled to cast away equipment and circuits and to create anew, in all its details, a system in harmony with recent progress," and with capacity sufficient to supply the incessant demand for service.

Then the financial papers have recorded how the Bell companies have increased their capital stock more than fourfold in as many years, being compelled to do so by a demand for telephones undreamed of five years ago. It is a demand that follows no known law save that of an awakening comprehension of the profitable utility of telephone service in every line of industry. It is not a demand governed by low rates; for it is so great as to tax all the resources of the Bell companies, although Bell rates are quite considerably higher than Independent rates.

Quite naturally a manufacturer of iron and steel products can build an up-to-date steel mill complete in every modern detail, and once the plant is in operation can close his capital account. Then he can continue to do a profitable business with a limited number of customers, none of whom care whether any new customers are secured. In fact, if the product of the mill is especially desirable, the smaller the number of buyers the better each customer is satisfied, and the more eager each is to secure all the product possible. But it is very different in the telephone business.

For experience has shown that soon after a telephone company begins to supply, it reaches the limit of its subscriber-capacity. Yet it perceives that to hold its present customers, it must increase its capacity. For the value of its product depends largely on the number of its customers; the greater the number of users, the higher the value of the service to each user. And then the directors perceive that no matter how widely the service is extended, or how many new subscribers are added, or how modern the new equipment may be, there will ever be an imperative demand for a service more comprehensive in character, and covering a wider scope. In fact, in order to maintain its prestige, a company must not only extend its initial exchange service to include all possible subscribers, but it must build exchanges in the important towns in each of the counties surrounding its own, and connect all these exchanges by toll lines. This means that eventually it may expend far more in these county toll lines and exchanges than the total amount invested in its city exchanges, only to find that its subscribers demand far more in the way of extra service, interurban, or otherwise, than the Bell ever gave.

MARVELOUS TELEPHONY.

The recital of marvels in connection with the progress of Independent telephony may seem to be superfluous at this time, so vast and so nearly incredible has been the past achievement. That achievement is known to all the world; and yet it is well to remember that the wonder still continues and still grows—that the most remote and hitherto isolated sections of the earth are now experiencing the effect of an

impulse generated but a few brief years ago in the minds of a handful of men that believed in opportunity, progress and fair play. TELEPHONY, in its issue for March, published a list of sixty-five new telephone companies incorporated during the month in the United States alone, representing an aggregate capital of approximately four and one-half million dollars. Nor should this be taken as a record of all companies formed during the period, or even of all new incorporations. New corporations are reported only when there is absolutely no doubt on the score of authenticity and when the exact location is definitely known. Thus many of the new companies which are every day springing into existence in villages and hamlets all over the country must go unrecorded. From among these unknown infants of to-day, however, will probably come more than one of the giants of to-morrow. That is the way of the telephone business.

In Indiana the movement has been especially marked. That state eight years ago contained over its entire territory not quite six thousand telephones, while now there are, of Independent telephones alone, eighty thousand, and it is predicted by Mr. S. P. Sheerin, authority upon the Indiana situation, that in five years' time there will be in use in his state over 500,000 telephones.

This modern miracle is being duplicated in each of the central Western states. Ohio, Illinois and, above all, Iowa are each undergoing a development that in any other industry would become the topic of conversation on every street corner, unless, as in this case, it should be incomprehensible because of its very vastness. Further west, in Colorado, Wyoming, Montana, the same thing has well begun, while the coast states are rapidly approaching their Eastern sisters. Down in New Mexico and Arizona meshes of wires vibrate over the sand wastes and in the important centers of population; construction and apparatus are of the highest improved types.

In Canada the days of monopoly and stagnation are being rapidly numbered. As would naturally be expected, the Independent cause is not so strong as in the United States; but the Bell is already being placed upon the defensive.

After all, we are only at the beginning. Notwithstanding the amazing advance of the last few years, the rate of progress is to-day greater than ever.

MUNICIPAL TELEPHONE EXCHANGES.

Is it true that a lessening in value and in diminished earning power naturally follows the agitation of the question of public ownership of local telephone systems? Now public discussion of this subject rarely culminates in practical action in this country. Thus far American taxpayers have been willing that English cities should enjoy the expensive luxury of building municipal telephone exchanges and then, when the charges for maintenance became an excessive burden, of selling the property at a sacrifice to the National company. But even the simple agitation of the subject in American cities has retarded the normal growth of the exchange. For many citizens who really need telephone service refrain from contracting with the local company in the hope of having a municipal service at far lower rates. The local company has no tax income on which to shift its debts. And what are taxpayers for but to make good the heavy deficit that is sure to appear at the close of each year's operations of a municipal telephone plant?

While no American municipality has yet established a competing telephone exchange, earnest efforts having that end in view have been put forth in many cities, notably in Evansville, Detroit and San Francisco. But fortunately the leading residents in these cities appear to look upon the question of securing an improved or more comprehensive service through municipal or governmental ownership in the same light that President Roosevelt does upon the government doing its own printing, and as Secretary Root looks upon the governmental control of army transports. "It is the province of governments to regulate and control, but not to administer." Again, as President Eliot so ably said: "If the Government enters a field which individuals or voluntary associations of individuals could till, it diminishes by so much the range or reach of the great school of self-governing freemen, namely: the school of creative industry under liberty and with responsibility."

Though based on false premises this belief in the saving virtue of municipal and governmental ownership is so widespread and so strongly permeating all classes of society, that its adherents may yet unite under the banner of municipal socialism and temporarily disrupt the two leading political parties, just as the populists did in Kansas. Mr. James B. Cahoon told the members of the National Electric Light Association that he seriously doubted "if there are in this whole association a dozen members who realize fully the gravity of the present demand for private ownership of public utilities." And he felt that until the people were willing to devote their time to studying both sides of the subject, that, for their own protection, "the electric light companies must adopt a uniform system of accounting containing all the factors entering into the true cost of production, and thereby show to the advocates of municipal ownership that to get the true costs they must follow our system. Our plan of defense must lie in the correct determination of costs, and in showing that we are only attempting to realize a legitimate profit on our investment."

After the same fashion it may be said that if the Independent telephone companies would adopt an approved and uniform system of accounting, it would go far towards proving how fallacious are the arguments of believers in municipal ownership. For then it could the more easily be shown that (1) unless each municipality had a highly trained staff, the local telephone service would prove very unsatisfactory, and if they did have it would prove very expensive for the taxpayers. (2) That there will always be at least one system far more comprehensive than any municipality or combination of municipalities could construct. Thus to gain access to all the subscribers to the service of the three telephone companies, the larger user of telephone service would be compelled to accept a telephone from each system, neither one of which would derive an income sufficient to warrant the outlay necessary to give its subscribers the highest quality of service.

HISTORIC TELEPHONE MODEL.

A duplicate of one of the first, if not the first, telephones has just been placed in the Hamilton Historical Library. It was presented by Daniel Drawbaugh, the inventor, of Eberly Mills, Pa.

The little machine is a quaint and crude structure compared with the present perfected machine. A tin can, lined with plaster of paris casting as the receiver, a tea cup covered with parchment and equipped inside with copper plates as the transmitter, the tiny electrical coils and the connecting wires—that is the machine that twenty-eight years ago enabled people to talk a distance of three miles.

The original is in the patent office at Washington.

WILL HARD TIMES DEPRESS THE TELEPHONE BUSINESS?

A paragraph in an interesting prospectus issued by an Independent telephone company reads as follows: "the telephone business is not influenced by political conditions or foreign affairs, nor is it depressed by hard times. The last thing that a telephone subscriber will dispense with in de-

pressed financial conditions is his telephone service. It is an absolute necessity in his business, and he cannot get along without it. When it is considered that a given sum of money invested in telephone service will bring more return to the investor, and more benefits, than the same sum of money invested in any other commodity, it will be readily seen what a very secure and important position telephone service occupies in business and social life."

The sentiment pervading that paragraph merits commendation in all respects save one. In past years the telephone business has been "depressed by hard times," and is as likely to be depressed again and to be again influenced by political conditions similar to those that prevailed in 1896.

The growth of the present Independent movement is popularly supposed to date from 1893, but it was not fairly under way until 1897. Thus it is correct to state that there have been no hard times to prove that the Independent telephone business may not be depressed during such periods. But a careful reading of the reports made by Bell companies leads to the belief that all telephone business may be seriously depressed by hard times.

The commercial depression that followed the financial crisis of September, 1873, continued in nearly all branches of industry until 1879, and in some trades even during that year. Indirectly this depressed condition retarded the introduction of the telephone and the building of telephone exchanges. In 1879 a noticeable increase in values and in the volume of business transacted was observed. Thenceforward, until 1883, substantial improvements in financial and commercial conditions are recorded. Then came the crisis of May, 1884, followed by an industrial depression that reached its lowest point in 1886, yet was not of so severe a character as that following the crisis of 1873. However, it had its influence on the growth of the telephone business, as shown by the annual report of the president of the American Bell Telephone Company for the year ending December 31, 1884, in which he states: "It has not been a year when new enterprises of any kind could easily be promoted, and, in common with other industries, the telephone companies have found it difficult to sell stocks or bonds for their construction purposes. It has been probably as much due to this as to the lessening of the demand for telephone service that our output of instruments has decreased. Most of the companies have met this condition of things by applying their net earnings in part, and in some cases wholly, to their new construction."

Then the statistics included in a later report show the number of stations in service at the close of each year, to which we have appended the yearly percentage of increase, as follows:

December 31.	Total stations.	Net yearly increase.	Yearly percentage of increase.
1882	97,728	.....	..
1883	123,625	25,897	26
1884	134,847	11,222	9
1885	137,750	2,903	2
1886	147,086	9,366	7
1887	158,712	11,626	8
1888	171,454	12,742	8

These statistics show that the hard times of 1884-85-86 reduced the yearly percentage of net increase from 26 per cent in 1883 to 9 per cent in 1884, and to 2 per cent in 1885.

The hard times of 1893-94-95 dated from the financial crisis in May, 1893, and embraced distress more severe than followed the crisis of 1873, but the depression was neither so far-reaching nor so long continued. For in 1895 there was a slight revival in trade conditions, with the natural reaction following political disturbances. But in 1897 prosperous times again appeared and all the world knows what marvelous strides have been made in all branches of industry and commerce during the past five years.

In his annual report for the year 1894, the president of the American Bell Telephone Company made the statement: "taking into consideration the fact that general business throughout the country has not recovered its usual activity, and that the growth of the telephone business must be in a great measure dependent upon the prosperity of commercial manufacturing interests, the results have been on the whole satisfactory."

The following statistics show the number of Bell stations in service at the close of each year during the last depression:

December 31.	Total stations.	Net yearly increase.	Yearly percentage of increase.
1892	232,140	26,123	13
1893	237,186	5,046	2
1894	243,432	6,246	3
1895	281,695	38,263	16
1896	325,244	43,549	15

These percentages seem to indicate that there is no special law governing the growth of the telephone business other than that which governs all industrial or commercial enterprises in periods of financial distress. It is the old story of the law of supply and demand governed by the factor of conditional profits.

CHANGING TELEPHONE NUMBERS.

Not all the changes in telephone numbers are made through the exigencies of business. A good many are made at the request of subscribers who are impelled to seek the change through mere whims. Men whose business it is to assign numbers to telephones and to distribute them among subscribers are authority for the not original statement that there is no accounting for tastes.

"Most people who insist upon a change," said one man, "wish a number that is more easily remembered than the old one, but occasionally we come across a person who takes a perverted view of life and he wants one that cannot be carried in the memory. I recall one man in particular who threatened to cut off the telephone service altogether if we couldn't give him a number guaranteed not to stick in the mind ten minutes after hearing it. That man lived in a big apartment house, where there were at least fifty other families, not one of which had a telephone. There was a general wire in the office, of course: but it had been christened with one of those outlandish numbers that nobody can ever keep track of; so when friends of the telephoneless families complained that it was so very difficult to hold converse with the inmates of that house on social and business topics by wire, because of their acknowledged inability to remember the number of the telephone and the unconfessed indolence which prevented their looking it up in the book, the telephoneless ones said, quite airily:

" 'Oh, that is no excuse. Just call up Mr. Smith and he will either tell you the proper number or take the message. Smith's number is 2,000. A baby could remember that. You will find Smith accommodating.'

"According to Smith's own account, they did find him accommodating. For six months he arranged dinners, weddings and funerals, collected insurance, swore off taxes and fought lawsuits for half the people in the house and their friends and relations about town. Finally things got so bad that Smith had to stay home from business and his wife and the maid let the meals burn to a crisp because they didn't have time to do anything but attend to the telephone.

"About that time Smith decided that he would change the number of the telephone and get something hard. He came

down here and told us he would like to change. We tried to be firm with him.

"'We never make a change without a good reason.' we said.

"And after he had told us his experiences we agreed that he had, and we let him pick out—well, I forget what number he did pick out. It is so queer that I can't remember it. Nobody can. I saw Smith once since then. He told me that everybody in the house was down on him, but that he didn't mind a little thing like that so long as he was free from the burdens of public telephone operator.

"There was another fellow named Smith who got tired of his old number. That Smith was a doctor. His number was 1,836 of some up-town exchange. Number 1,836 of another exchange was owned by a cemetery company, and Smith said it used to make him feel creepy, considering his profession, to have people call him up at all hours of the day and ask for information in regard to burial lots. He got a new number, too, without any trouble.

"Another complaint was made a short while ago by a druggist. I don't remember his number, but I do know it was the same as that of a brewery that was enrolled in another exchange, and the clerk said it made him feel as if he was violating the excise laws for folks to call him up nine or ten times a day and ask him to send around 400 kegs of beer or something like that. And, besides, the number caused dissatisfaction among his customers. Often they would request their friends to telephone them at his number, and the friends, mistaking the exchange, would call up the brewery, which not only caused inconvenience, but some suspicion."

CHANGE IS ADVOCATED.

Some months past the city council of Chicago appointed a committee for the purpose of ascertaining a way for the improvement of telephone service and an equitable adjustment of telephone rates. After conducting an investigation which has extended over the cities of this country and into foreign countries, the committee recommends in substance "the substitution of measured rates or measured service; a schedule of telephone charges in place of the present flat rate system; an increased compensation to the city from three per cent annually of the gross earnings, which is the present rate, to five per cent; and an action by the corporation counsel to force the company to stop collecting unreasonable toll charges."

In their report the committee has placed users of telephones in a classification, classifying them according to the number of calls the user makes and providing that any excess of that number of calls shall be charged for at a minimum rate. In business houses where the calls average 600 or less the price per year is $60, and for each call in excess of 600 and under 800 the user is required to pay five cents a call. The rates above that are $70 for 800 calls, $80 for 1,000 calls, $88 for 1,200 calls, with four cents a call excess, $100 for 1,500 calls, $109 for 1,800 calls and $118 for 2,100 calls. For a two-party line the charges vary from $44 for 600 calls to $80 for 1,500 calls, and for four-party lines from $28 to $68 for the same number. It is recommended that the 10-party-line service be abolished if it cannot be improved. A rate of $18 for 300 calls is fixed for this service.

"The division is necessarily an arbitrary one, but it represents a material decrease in rates to at least 85 per cent of the present telephone users, based on their present average use of the telephone," says the report. "If it were possible to secure more accurate information of the number of calls made from telephones on the different classes of service a reduction of charges in some classes, a proportional increase in other classes might be made and result in a more equitable rate throughout.

"We believe that the application of the message-rate system will have a favorable effect in increasing the efficiency of the service. It is the application of the old principle, 'pay for what you get.' Unquestionably the imposition of this system will limit the number of messages sent in many instances. This will result in quicker and more reliable service in the case of important conversations over the telephone, the use for which it is primarily designed."

TELEPHONY AT PURDUE UNIVERSITY.

Purdue University has been the recipient of a four-station automatic telephone system, which now forms one of the most interesting and instructive parts of the telephone laboratory. With this particular type one thousand lines may be operated. The Automatic Electric Company has spared neither expense nor trouble in arranging this equipment, and Purdue may now be said to have one of the broadest and most comprehensive telephone laboratories in existence.

The Kellogg Switchboard and Supply Company have added extensively to their original apparatus, and all the new and late features of engineering may be tested out in an exhaustive manner. Circuit tests and transmission tests, along with all the late ideas of supervision and operating, fit the student for nearly all branches of practical telephone work.

Purdue expects shortly to have a laboratory to which the manufacturer, operator and inventor may look for great and efficient results.

THE NEW 'PHONE.

BY MERLAN CHADMER BARRY.

The 'phone came in this morning, John; they put it in the hall,
And isn't the strangest thing to ring the bell and call
Some friend who lives a mile away, or maybe two or three,
And hear her voice so plain and clear you'd almost think that she
Were standing at your elbow? Oh, isn't it just great
To call up every one you know and simply satiate
Yourself with all the gossip that is going in the town,
And talk to Mrs. Jones and Smith and Black and Green and Brown?

I didn't use it very much—just called a friend or two.
I talked with Bessie Buckley and Sadie Donahue,
And said good-morning to the Speers and had a talk with Jess
McCutcheon, Jack and Essie Nash, Nell Jones and Mrs. Hess.
I chatted with the Stevens girls and called up Mollie Kane,
Ede and Sadie Merrell and Matilda Castlemaine.
The Smiths were not at home, and so I called up Kitty Krouse
And chatted for a while with her and Mrs. Westinghouse.

I couldn't raise the Robinsons—their 'phone was out of whack;
The Martin line was busy, so I called up Stella Black,
Who said she hadn't tried to do a blessed thing all day
But call our number, and each time the hello girl would say
Our line was busy. Goodness me! I never heard of such
Dissimilation in my life—I hadn't used it much,
So just for spite to-morrow I'll call every one on earth
And show that hello girl I mean to get my money's worth.

The Home Telephone Company of Elkhart, Ind., recently made an increase of twenty-five cents in its monthly rental rate. Only two subscribers have discontinued their use of the service since the increase.

QUESTIONS AND ANSWERS

Conducted by J. C. KELSEY, Professor of Telephony, Purdue University.

There is a bridged grounded line under my supervision that has one telephone on it which requires a vast amount of battery from some cause unknown to me. There are sixteen instruments on the line, American type, and this one telephone requires new batteries each month. I find that this instrument is not used enough to consume this amount of energy under ordinary circumstances and the transmitter seems to be in good condition. The batteries are Le Clanche, two cells.—L. M. M.

This case seems to be one in which the receiver, while on the hook, does not open the primary circuit. It may be that the hook spring is faulty, or that the insulation has been broken down at some point not visible, which keeps the primary circuit closed. We would suggest the following test to see if any battery is flowing; for it may be that the instrument is wired wrong and possibly the current is flowing through the ringers: Simply hold down the hook, or it would be better to use another receiver, and leave the old one on the hook, open the battery circuit at any of the battery terminals, say the zinc terminals, and connect the receiver in series, that is, by tapping the loose terminal on the now loose battery wire. If you get a succession of clicks, it proves that an unnatural leak exists. Open the primary circuit, as shown in Fig. 1 at the point P1, and if this click still continues, it would seem to indicate a crossed induction coil. If such were really the case, according to the figure, the battery would flow unceasingly through the transmitter, receiver, and the bridged bell. This would allow the battery to run down slowly, yet without seriously affecting the transmission value of the instrument. We do not even assume that the Fig. 1 is the way your instrument is wired, it is only to illustrate the suggestion concerning a possible bad induction coil.

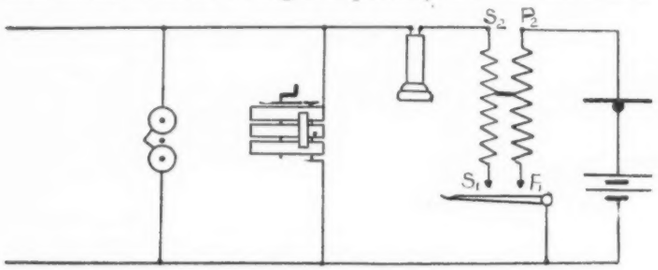

FIG. 1.

Is it necessary to place a fusible lightning arrestor at each subscriber's telephone, and ground it, or is the grounding of the arrestors on the telephones all that is necessary? If there are no fuses, or a ground at the subscriber's telephone, how long should a line be from the exchange before it would be necessary to place a fusible arrestor at the telephone and ground it?—H. O. H.

The experience of the old companies has led to a tendency to place fusible arrestors at each and every subscriber's station. As mentioned in the April TELEPHONY, the action of lightning follows out no set rule. Lines that pass through woods seem to have more shivered poles than those in the open. Such lines should be extra well protected by the fuses. This seems to be a better way than to judge the needs of a line according to length. It is true that a long line will necessarily feel more effects of the various lightning charges, because each line is like the secondary of a transformer; the amount induced in the line, or secondary, depends upon the length of the secondary wire. But such charges are usually harmless, and if the metallic line had no ground of any kind, there would be no temptation for the charge to go to the ground, except when it has a path, say, through a thousand-ohm bell. We should judge from ordinary Indiana conditions that the latter part of the question would be all that was necessary, and even that unnecessary, too. But such lines should have protection at the switchboard, by all means.

Recently I read in one of the electrical papers of a windstorm, when the temperature was below zero, that blew the air full of fine snow, setting up a peculiar electrical disturbance. Can you cite me to this article?—E. W. S.

January TELEPHONY discussed the effect of wind storms, driven snow and wheat chaff, but did not dwell upon the effect of zero weather. It is probable, therefore, that the January article does not exactly fill the bill.

I have under my inspection a grounded bridged line of sixteen telephones. Some of the parties have placed switches on their telephones to cut the batteries out while just listening, making the transmitter dead, or to turn it on when they want to talk. Does it not save the batteries, or does it affect the line in any way?—L. M. M.

Such a device on a farm line as you mention is undoubtedly uncalled for. Legitimately, it does not save battery at all. When used for sneak listening it does save battery, of course, and has no effect on the line, except to prevent the action of listening to be known to the other parties talking. We can imagine that it would be a comfort to have such conditions on a sixteen-subscriber line.

Some time ago you mentioned a "phantom" telephone. Why is it called phantom, and what is a phantom telephone?—R. N. T.

The expression "phantom" is applied to a circuit that is used for dual purposes. For instance, a metallic telephone line is used for telegraphic purposes. The telegraph circuit may be said to be a phantom circuit, because there is no real evidence of its presence on the telephone line. The word has been chosen because it expresses more fully the state of affairs than any other word. A telephone circuit that is made by the combination of two metallic telephone circuits, so that speech may be passed through all three circuits without interference, that is, such as cross talk, may be called a phantom circuit, for above reasons applied to the telegraph circuit. "Phantom telephone" is a misnomer.

The sketch shown in Fig. 2 is a diagram of a rural line, grounded service. This morning I asked for station C from station I for the purpose of finding out the trouble on the line. B, C and D can ring central at any time, and can understand well what is being said. B can ring central at any time, but C and D can ring central only under most favorable circumstances. I think that the trouble lies in C and D having weak generators. Am I not right? Central can ring B and D, but C rings weak. But the following is what I do not understand: While I was talking this morning (each telephone has two new batteries, and the transmitters are of the long distance type) I could distinctly understand B, C and D (C better than I could any of the others), but C could not understand one word that I could say, although he could understand all the rest, and I could be clearly understood by B and D. Why is this? I thought it was a

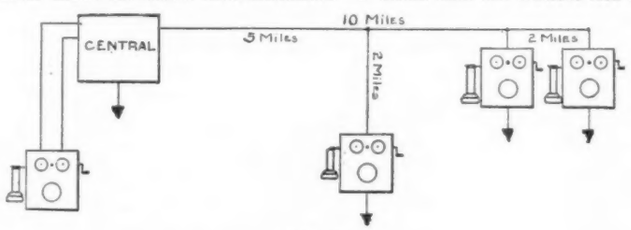

FIG. 2.

faulty receiver at C, but that can't be, for he heard D and B without trouble. I then thought the trouble was in my I transmitter, but I was heard clearly at central and at D.

If we may be allowed to assume that a repeating coil connects the grounded and metallic line, the trouble seems to come from two reasons. First, that a leak exists on the line between instruments D and C. This cuts down the ringing strength of magnetic generators of D and C. This may account for the tendency of D and C being able to ring central on most favorable conditions. The wire may be grounded in a tree or in some other wire. As to the reason for subscriber I hearing C, and C being unable to hear I, this may be laid to a receiver with poor adjustment. It is possible that the talking currents induced from I are weakened in such a manner as to be much lower than the talking currents induced at B and D. Even without assuming that there is a repeating coil at central, the weak receiver may account for the difference. We would suggest changing receivers, and if this does not help matters, examine the instrument connections, and test the induction coil. Then disconnect line on right of instrument D, and test from C for leaky line.

We have a No. 2 No. 12 B B iron-wire line with stations as shown in Fig. 3. First, what is the resistance of all-line and ringers? Second, what is the resistance with station No. 5 cut off at No. 4? Third, what is the resistance with No. 7 cut off at No. 7? Fourth, what is resistance with cross at station No. 8? All measurements are to be made from station No. 1. Please give rule and example how to work, as we have some argument about the proper way of measuring a line with several telephones in bridge. Bells in No. 3 and No. 7 have 1,600 ohm ringers. Bells at other places have 1,000 ohm ringers.—C. N. S.

This is a case of electrical measurement, which seems to have been avoided by the text-books and other formula givers. Not that the proposition is difficult, but that such a combination never appeals to the man of abstract calculations. It would be a simple matter to measure the nine stations, if they were all tapped onto the same point on the

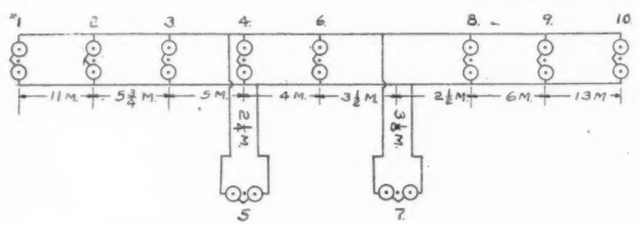

FIG. 3.

toll line. Then the ordinary rule of divided circuit would easily apply. But in this case, there is a rare combination of series and multiple resistances, and it would appear that a formula covering all the points would be unusually long. The following calculations all depend on the simple formula of the divided circuit. That is, the total resistance of the circuits is equal to one divided by the conductivity of all the circuits. For instance, we have a 1,600-ohm ringer and a 1,000-ohm ringer in parallel. The conductivity of the 1,600-ohm ringer will be $\frac{1}{1600}$. That is to say, it will carry that fraction of the current when in parallel with any other resistance. The conductivity of the 1000 ohm ringer will be $\frac{1}{1000}$, or the fraction of the current that it will conduct. Adding the amounts, or conductivities, we have $\frac{1}{1600}+\frac{1}{1000}$, or $\frac{5}{8000}+\frac{8}{8000}$, or $\frac{13}{8000}$. This amount is the conductivity, and to find the total resistance of the circuits in parallel, divide one by this amount, or $\frac{1}{\frac{13}{8000}}$, or $\frac{8000}{13}$, which is $615\frac{5}{13}$. Or given a parallel circuit with 2, 3, and 4 ohms. Here we have three conductivities, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, the sum of which being the total conductivity, or $\frac{6}{12}+\frac{4}{12}+\frac{3}{12}$, or $\frac{13}{12}$. The total resistance of the divided circuits is $\frac{1}{\frac{13}{12}}$, or $\frac{12}{13}$ of an ohm. Ordinary No. 12 iron wire has an average resistance of 33 ohms per mile. That will be assumed to be correct in the following calculations.

The resistance of the station No. 2 circuit alone would be 330+330+1000, or 1660 ohms, figuring that the ten miles of iron circuit is equal to 330+330, or 660 ohms. To find the resistance of circuit with station No. 2 and

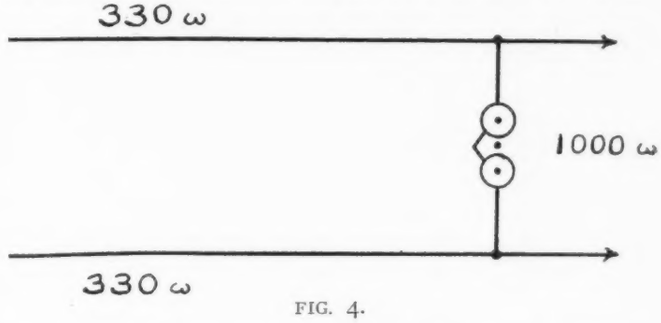

FIG. 4.

No. 3 alone brings into use the divided circuit formula. We find that the 1000 ringer of station No. 2 is now paralleled by 1600 ohm ringer of station No. 3 plus the line resistance, which is 190+190 ohms, then we have a combination, $330+330+\frac{1}{\frac{1}{1000}+\frac{1}{(190+190+1600)}}$, or 330+330+664.6, which is 1324.6. (Res. to No. 3).

Having found the resistance of circuit with but stations No. 2 and No. 3 included, we now proceed to find the

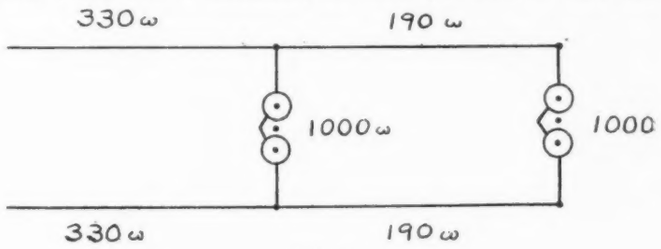

FIG. 5.

total resistance with station No. 4 included. It will soon be observed that each additional party only affects the resistance but slightly, and after a certain number of stations are bridged, it is doubtful that even a good measuring instrument will detect the addition, or subtraction of a subscriber. According to Fig. 6, we have a change made all along, that is before we figured the ringer of

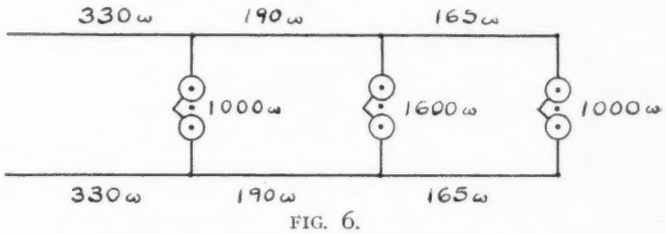

FIG. 6.

station No. 3 at 1600 ohms. With station No. 4 in parallel with it, it will be $\frac{1}{\frac{1}{1600}+\frac{1}{165+165+1000}}$, $\frac{1}{\frac{1}{727}}$, or 727 ohms. This being put in parallel with station No. 2 makes quite a little difference. Putting this resistance plus the two 190 ohm line resistances in parallel with station No. 2, we have $\frac{1}{\frac{1}{1000}+\frac{1}{727+190+190}}$, or 525.3. Then the resistance of circuit with station No. 4 included would be 330+330+525.3, or 1185.3 ohms. (Res. Station No. 4).

So far it is observed that each additional subscriber lowers the total resistance of the line. Station No. 3 reduced it from 1660 to 1324.6, or 335.4 ohms. The addition of station No. 4 reduced it still farther from 1324.6 to 1185.3, or 139.3 ohms, which is considerably less. The addition of station No. 5 will be still less, as will be seen

from the following. Before we figured station No. 4 at 1000 ohms. This is no longer true, because station No. 5 has put its line resistance and the 1000 ohm ringer in parallel with it. So the true resistance of station No. 4 will be $\frac{1}{\frac{1}{1000}+\frac{1}{74+74+1000}}$, or 534.4. Putting this in place of the original 1000 ohm resistance, our equation is changed. It now stands $\frac{1}{\frac{1}{1000}+\frac{1}{165+165+534.4}}$, which is $\frac{1}{\frac{1}{941.2}}$, or 561.2 ohms. Putting this new resistance in the formula, instead of former resistance offered by station No. 3, we have 190+190+561.2, or 941.2 ohms in parallel with the 1000 ohm ringer at station No. 2. The total will be then, $330+330+\frac{1}{\frac{1}{1000}+\frac{1}{941.2}}$, or 330+330+585, or 1145 ohms (Res. station No. 5). It will be observed that the

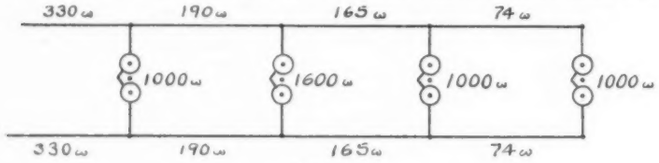

FIG. 7.

addition of station No. 5 has reduced the total line resistance from 1185.3 to 1145, which is 40.3 ohms less. Later the effect of cutting off station No. 5 will be shown.

Including station No. 6, according to Fig. 8, we find that the 1000 ohm ringer is now paralleled by two paths—that of station No. 5 and that of No. 6. It will be $\frac{1}{\frac{1}{1000}+\frac{1}{74+74+1000}+\frac{1}{132+132+1000}}$, or 373 ohms. The station No. 4 will now offer a resistance of 373+165+165, or 703 ohms, to be placed in parallel with station No. 3.

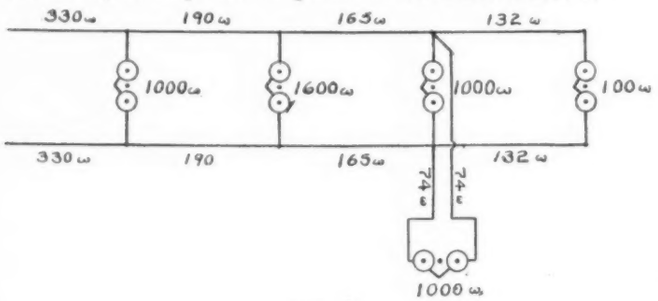

FIG. 8.

This will reduce the resistance offered by station No. 3 to $\frac{1}{\frac{1}{703}+\frac{1}{1600}}$, or 489 ohms. This in turn reduces the resistance offered by station No. 3 to $\frac{1}{\frac{1}{1000}+\frac{1}{190+190+489}}$, or 465 ohms, which added to the line resistance of station No. 2 gives 330+330+465, or 1125 ohms. Observe that

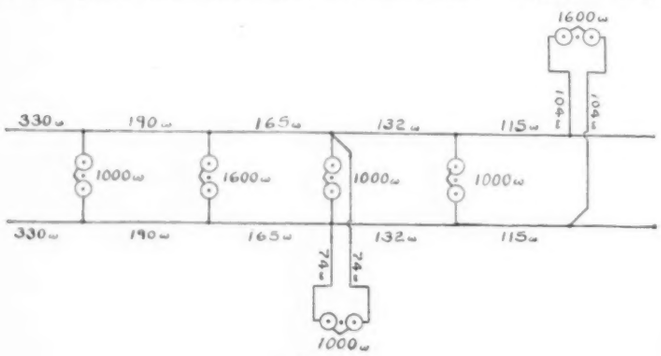

FIG. 9.

the general line resistance has been reduced from 1145 to 1125, or only twenty ohms.

To find resistance with station No. 7 included, according to Fig. 9, we find that we have in parallel with the ringer of station No. 6 the following resistances $\frac{1}{\frac{1}{1000}+\frac{1}{104+104+115+115+1600}}$, or a total of 667 ohms.

Before this station No. 6 has been offering 1000 ohms resistance, besides its line resistance, to station No. 4. It now offers 667+132+132, or 931 ohms. Now in parallel with station No. 4 is the station No. 5 also. It makes a three path circuit, composed of $\frac{1}{\frac{1}{1000}+\frac{1}{931}+\frac{1}{74+74+1000}}$, or 339 ohms. This puts 339+165+165, or 669 ohms in parallel with station No. 3, or $\frac{1}{\frac{1}{1600}+\frac{1}{669}}$, or 472 ohms. Putting this in parallel with station No. 1, we have $330+330+\frac{1}{\frac{1}{1000}+\frac{1}{190+190+472}}$, or 1120 ohms. Observe that the line of resistance has been reduced but five ohms by the addition of station No. 7.

To find station No. 8, according to Fig. 10, first notice

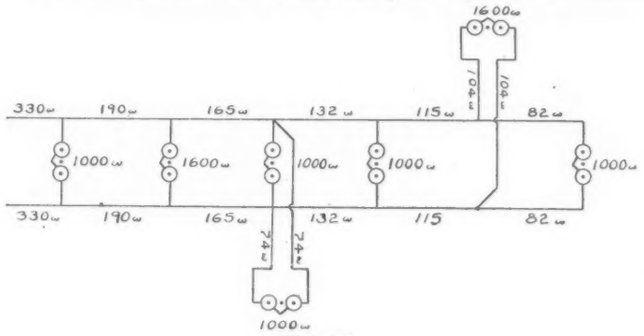

FIG. 10.

that there is a junction point $3\frac{1}{2}$ miles beyond station No. 6. This puts into parallel with station No. 6, the following series and parallel combination:

$115+115+\frac{1}{\frac{1}{104+104+1600}+\frac{1}{82+82+1000}}$, or 940 ohms. This makes the total of six, No. 6, $\frac{1}{\frac{1}{1000}+\frac{1}{940}}$, or 437 ohms. This puts into parallel with station No. 4, the following, $\frac{1}{\frac{1}{1000}+\frac{1}{74+74+1000}+\frac{1}{437+132+132}}$, or 303 ohms. This puts 303 ohms plus 165 plus 165, or 633 ohms in parallel with station No. 3. $\frac{1}{\frac{1}{633}+\frac{1}{1600}}$, or 453 ohms. Putting this and the line resistance in parallel with station No. 2, and $330+330+\frac{1}{\frac{1}{453+190+190}+\frac{1}{1000}}$, or 1114 ohms, notice that station No. 8 has reduced the line resistance only six ohms.

To find station No. 10, and the resistance of the entire line, we will find the effect upon station No. 8 of being paralleled by stations No. 9 and No. 10. Station No. 10 puts 429+429+1000 ohms in parallel with the 1000-ohm ringer of No. 9. This makes $\frac{1}{\frac{1}{1000}+\frac{1}{429+429+1000}}$, or 650 ohms. Station No. 9 then puts 650 ohms in parallel with the 1000 ohm ringer at No. 8, or $\frac{1}{\frac{1}{1000}+\frac{1}{650+198+198}}$, or 511 ohms. The same method will be employed, in order to show the various steps. It is plain now that the addition of stations No. 9 and No. 10 will hardly be apparent to a measuring instrument at No. 1. Going back to the calculation of station No. 8, and substituting 511 ohms instead of 1000 ohms, we have 115+115+ $\frac{1}{104+104+1600}+\frac{1}{82+82+511}$, or 268 ohm. Observe that before it came out 940 ohms. Substituting further, we have now in parallel with station No. 6 the following:

$\frac{1}{\frac{1}{1000}+\frac{1}{268}}$, or 233 ohms. This puts in parallel at station No. 4 the following, $\frac{1}{\frac{1}{1000}+\frac{1}{74+74+1000}+\frac{1}{132+132+233}}$, or 260 ohms. This puts 260+165+165, or 590 ohms in parallel with station No. 3, or $\frac{1}{\frac{1}{590}+\frac{1}{1600}}$, or 431 ohms. Putting this in parallel with station No. 2, and adding the line resistance, we have $330+330+\frac{1}{\frac{1}{431+190+190}+\frac{1}{1000}}$, or 1108.4. From this result we can see that the addition of

stations No. 9 and No. 10 have only reduced the line five ohms in resistance. There has been a descending scale, and while No. 9 and No. 10 have reduced the line resistance a little, the addition of further stations will affect the total less, and it will be hard to get measurements to find out trouble, for so many combinations may be made that it would be nearly impossible to form conclusions from measurement results.

It will be seen by inspection that if station No. 5 were cut off, the result would be more noticeable than to cut off station No. 7. A short circuit at station eight would not have much effect upon the readings of a measuring instrument. Suppose that a short circuit existed at station No. 8, we could begin with the formula which gave us the measurement of station No. 8. Substituting, and putting 0 in place of the 1000-ohm ringer at No. 8, we have as a starting formula, $115+115+\frac{1}{\frac{1}{104+104}+\frac{1}{1600}+\frac{1}{82+82+0}}$, which can be worked down to circuit No. 2 and a result of 1110 ohms or nearly that, will be obtained. This result would be very nearly the same that would be obtained, if the line were measured with the station No. 10 cut off. So a short circuit at No. 8 has only the difference between the resistance of the whole line, 1108.4 ohms, and 1110 ohms, which is only one and a half ohms. Rather a fine point to separate. If the station No. 5 were cut off, then the formula for finding the whole line could be changed to this, $\frac{1}{\frac{1}{1000}+\frac{1}{132+132+233}}$, which could be reduced, and a result would be obtained something like 1131 ohms. Then with station No. 5 cut off we have a result similar to that obtained when the line was cut open beyond station No. 6.

If station No. 7 were cut off, the formula could be changed from $115+115+\frac{1}{\frac{1}{104+104}+\frac{1}{1600}+\frac{1}{82+82+511}}$, to $115+115+\frac{1}{82+82+511}$, which could then be reduced as all the former equations. It would give a result of about 1115 ohms. This lacks one ohm of equalling the line resistance with all stations cut off beyond No. 8. The cutting off of station No. 7 would cause an increase of resistance of six ohms or a little more. The cutting off of station No. 5 causes an increase of 22 ohms. So many combinations can be found that readings of the measuring instruments can be interpreted to mean almost anything. This reasoning may not be what is desired, and if not, the department asks for more questions and suggestions along the same line.

A ST. PAUL STORY.

The telephone has its drawbacks as well as its advantages. You cannot always depend upon it to transmit sound with exact fidelity, and if there is one word about which you are particularly careful that is the one which will be confused in transmission.

In the House of Representatives the other day a member was sitting at his devotions when he was suddenly called to the telephone with the information that he was wanted at Minneapolis. Only one side of the conversation could be heard, of course, but filling in the blanks in the only possible manner, that is, by construing what was not heard by that which was heard, here is the conversation:

Minneapolis—"Hello!"

St. Paul—"Hello!"

Minneapolis—"Is that Mr. John Dahl?"

St. Paul—"Yes; this is Mr. Grondahl. What is it?"

Minneapolis—"Why, say, why didn't you come out last night as you agreed to?"

St. Paul—"Oh, excuse me; what was that?"

Minneapolis—"I say, why—b-r-r-r-r as you said you would?"

St. Paul—"Why didn't I come out where?"

Minneapolis—"Why, out to the house, of course. Do you suppose I meant b-r-r-r?"

St. Paul—"Why, I was at the house. There was a night session.

Minneapolis—"Well, I should say there was a night session, and you weren't in it. I told mamma, you——"

St. Paul—"Say, who do you think you are talking to, anyhow?"

Minneapolis—"Why, to Mr. John Dahl, of course. Isn't it you?"

St. Paul—"Yes, I'm Mr. Grondahl, and I am trying to figure out what in the name of Brian Boru you're talking about."

Minneapolis—"Well, I don't think that's very nice of you. You know you said you'd come out and sing with us, and——"

St. Paul—"Now, look here; you know I never said any such thing. I haven't tried to sing since the Albert Lea caucus, when I tried 'Rally Round the Flag,' and if I live I'll never——"

Minneapolis—"Why, what do you mean by talking like that, John Dahl? Didn't you sing 'The Last Link Is Broken' and 'Sally in Our Alley' at the last rehearsal we ——"

St. Paul—"Now, look here! What kind of a bunco game is this, anyhow? And it is funny that you should address me as 'Grondal' without the 'Mr.' If I know you well enough to warrant that you can call me Jens."

Minneapolis—"Why, I didn't know you had a middle name, Mr. John Dahl, and if you insist I will give you the whole thing, Mr. John Jens Dahl."

St. Paul—"What's that? I say, isn't there some mistake? I don't—who are you, anyhow?"

Minneapolis—"Well, if I've been talking all this time without your finding out, and if you expect me to yell my name out here in the store, and if you don't know where you promised to come last night, you can just guess at it. I didn't know you drank."

St. Paul—"Say, I'm getting into an awful state. I don't know who you are or what you are talking about, or what it is all about or anything. Are you sure this is me—that is, are you sure you know who you are talking to? Spell it out."

Minneapolis—"J-o-h-n, John. D-a-h-l, Dahl, John Dahl."

St. Paul—"O, well, that is different. My name is G-r-o-n, Gron, d-a-h-l, dahl, Grondahl, Jens K. Grondahl, and I never promised to come 'out' last night, and I don't know who you are, and I don't sing and I don't drink. If you'll wait a moment I'll find Mr. John Dahl and he can square himself the best way he knows how, for my bicycle bill is coming up in a few minutes and I have troubles of my own."

Minneapolis—"B-r-r-r-r!"

FARMERS INDEPENDENT SYSTEM GROWING.

The growth of the telephone service among the conservative farmers of Lancaster County, Pa., in the last few years has been amazing. It was only recently that the telephone was classed as iniquitous by many of the wealthy farmers belonging to the quaint but strict sects with which the rural districts abound. This is now all changed, and many a farmer invests his money in a local telephone company first and then has an instrument installed.

The business formerly transacted between the farmhouses and the stores and banks in the rural centers, which necessitated many trips by team, is now over the wire. In a number of the small towns of the county, telephone companies owned and operated exclusively by and for farmers are flourishing. Fence posts, trees and poles are utilized for stringing wires, and the service is good. A rural telephone service, taking in New Holland, Fern Hill, Hinkletown, Earville and Martindale, is in operation, and the stockholders are residents of the towns named.

Are Country Telephone Lines Profitable.

Second Paper by A. E. Dobbs.

I wish to repeat what I have said before, that farmers having learned the value of the telephone are bound to have it. It would seem that the manager who builds a town exchange and makes no arrangements to take care of the rural business in his territory is inviting competition, for whereas the farmers before his advent might have been only talking or thinking about building lines, the construction of an exchange in town advertises the business and brings home to them more than ever the need of telephones in their own houses. More than this, nearly every agricultural and rural paper at various times during the season prints articles from farmers who have built their own lines, showing how by the use of black jack poles, porcelain knobs, fence wire costing $3.10 per mile, and the use of such help as can be spared from farm work, it is possible to build a farm line that may last a year and a half, for about $26 a mile. This being the case, it is but natural that they should wish to try it for themselves.

There is but one way to forestall work of this kind, and that is by first building the town exchange in such a manner that every farmer who comes to town will see large stout poles set in line, wires pulled tight where open wire is used, corners so well guyed and anchored where these are necessary that slack wires are never seen, and cables level and well aligned—work put up in such a manner as to command respect, put up in such a manner that good construction and skill is indicated at every step, so that they will see at a glance they can never hope to imitate it with the limited experience and class of labor they have on the farm.

It may be objected that money cannot be obtained for construction of this kind, but this is a mistake; for when men who have money to invest are convinced that the construction and management will be of the best, instead of the slipshod kind often met in small towns, there will be no trouble in obtaining all the money needed. In proof of this it might be mentioned that certain firms of constructing and promoting engineers operating in the Middle West have achieved such a reputation for first-class work that people of even limited means will take their savings out of the banks to invest in telephone stock when it is known that this or that particular firm will install and retain an interest in the exchange. These firms never buy cheap material or employ cheap labor, and the best that money can buy is not any too good for them. Every one of their exchanges pays dividends from the very start and their maintenance account is always at a minimum.

When firms of this character can produce letters from their clients showing that their exchanges are paying good dividends after paying all taxes, interest and depreciation accounts, they have very little trouble enlisting all the capital they need.

Why do old-established companies, like the Western Union, Postal Telegraph and Bell telephone companies, buy the very best material and spare no expense in construction? Simply because experience has taught them that nothing but the best will pay dividends. The wisdom of this course is proved by the fact that one troubleman is expected to care for about 100 miles of pole line, and even this is regarded by the men as an easy task.

Why is it that some exchanges need one troubleman for every hundred subscribers? Because their construction is so bad that they have to employ several men to do work that with good construction could be taken care of by one. Such exchanges do not pay dividends, and not a few of them have gone out of business, while nothing but the fact that local pride prompts people to support them keeps them in business at all.

If a rural community sees a town exchange built with weak poles, set in shallow holes, standing at almost any angle but a vertical one, set without regard to alignment, without adequate guys, wires hanging so low that a farmer riding on a load of hay is in danger, and so loosely pulled up that they will cross every time the wind blows, the agriculturalists, naturally, conclude that a gang of farm hands can build a plant as good as that, and feel tempted to try it for themselves. And then trouble begins for the go-as-you-please town exchange connected to a lot of Happy-Hooligan country lines, the owners and patrons of which, like that famous character, mean well, but are always in trouble.

When patrons of such lines try to ring the exchange they do so with mingled feelings of hope and anxiety; agreeable surprise if the call is answered, and the connection obtained at the first ring, or, a more or less patient sigh of resignation if they fail to get the desired connection at all.

In justice to the exchange manager, however, it can be said that this condition of affairs has often grown out of circumstances which he could not, or rather did not, foresee. In many instances a country storekeeper has built a few lines to connect with some of his customers, never thinking to build or operate an exchange as a business, but lines are added one by one until he finds that poles intended to carry a dozen wires are overburdened with a hundred. Once get a telephone exchange started, and, if it gives a half-decent service, it grows like a prairie fire—the larger it becomes the faster it spreads. This being the case, would it not be well to anticipate local opposition by securing a franchise for the surrounding territory at the same time that building begins in town—and then entrust the work to someone who knows how to build exchanges, and not some farmer's boy who has just left school, and who cannot have obtained the experience necessary to do first-class work?

When building in town figure the ultimate capacity of the exchange at one-eighth of the population in towns of 4,000 or less and one-tenth of the population in towns of 6.000. When building in the country districts count the number of houses and estimate one telephone for every house. That is, select poles of sufficient size and make stays or guys strong enough to carry that number of wires, if they are needed, allowing six subscribers to each line. This may seem extravagant at the time; but it will not be long until the line is filled, provided the town service is good, as it undoubtedly will be where this class of construction is carried out. If I were laying out a route of this kind myself, I believe I should economize in construction work by stringing about four times as many wires as were actually needed to supply the immediate demand. To illustrate, let us take a certain road and canvass for subscriptions to the limits of our legitimate territory, which we will suppose to extend six miles from town. Let us suppose that there are thirty good farmers living near enough to be served from this line, but, after canvassing the line, we secure only ten at the time of building. It will be a safe proposition to expect that ultimately at least twenty-four of the thirty would become subscribers, which would mean four circuits.

One circuit would run the entire length of the line and be dead-ended at the last pole on a double arm; the second dead-ended at four and a half miles; a third drop off at three miles, while the fourth would stop at, say, two miles. For distances as great as this it would pay to run the lines as metallic circuits properly transposed; for, after the pole line is built, wire does not cost a great deal, and the service given by metallic circuits is much more satisfactory.

Now for the economy of this method: The most costly method of stringing circuits is to string them one at a time. A gang of men engaged in construction work will string the four circuits almost as quickly as they would one. Then when connections are to be made it is a simple matter to run a tap from the house to the pole line—a matter of one or two hours' work for one man and a helper.

This method would, it is true, tie up some capital in wire for the time being, but the saving in labor would more than pay interest on the capital, which, after all, would only remain tied up a short time.

For lines not more than fifteen or twenty miles in length, No. 12 B. W. G. double galvanized steel is about as satisfactory as any, although, of course, copper would be still better, but more expensive. Lines built in this manner will never encounter opposition enough to keep the manager awake nights. The farmers will respect a company who can put up work that is beyond their skill, and even if they do feel disposed to build a section of the line themselves, it will sometimes be found effective to reason with them, advancing the following reasons:

If you wish to build this line yourselves and connect with us, we will give you the desired connection provided your lines are of standard construction and that you agree to keep them in good repair. Our exchange is constructed to give a good, constant and reliable service. We cannot imperil our reputation for good service by connecting with a cheap and poorly constructed line. In order to obtain connection with us it is necessary that all your poles should measure at least 20 inches around the top, and 36 inches circumference five feet from the butt. We want these poles set five feet in the ground and gained for at least one cross-arm (while you are about it you might as well cut two gains). We will also furnish an experienced man to oversee your construction and materials, if you desire, at the cost of his labor to us. Or should you desire to furnish poles and labor, we will make you proper allowance therefor and take over the line in exchange for stock in our exchange. In this way part of the money you pay out for rentals is returned to you in profits, so you will be receiving service at the cost of operation and maintenance. We are willing to entertain any fair proposition, but in justice to ourselves we must insist upon good service from your lines, because the exchange receives the blame for poor service. To obtain good service the construction must be good, for experience has taught telephone men that reliable service cannot be obtained from shaky poles, cheap instruments and poor wire.

If the manager can back up this logic by showing examples of good construction and good service, he is likely to find the work left entirely in his own hands. With proper construction, which costs but little more than poor, slipshod work, the maintenance account is low and the line lasts ten or twelve years, instead of two or three. It may also be said that the plan of running out all the wire at once instead of stringing one circuit at a time has been given a trial and found to be good practice.

Outside construction is really the most important part of the plant; for, if the lines are good, almost any manufacturer can furnish instruments and switchboards that will give good service. If, however, economy must be practiced anywhere, let it be in the inside rather than the outside. A metallic circuit board will give good service even though it is not a central battery outfit. Up to 500 subscribers there is no need of installing anything but a magneto drop board. The drops should be of the self-restoring type, which not only saves the operator's time, but also allows of easy removal for repairs. If the drops are covered by an iron tube shield, so much the better, as the shield not only prevents cross talk, but acts as a safety device in case a drop is burnt out, as it cannot scatter fire to other parts of the switchboard. The shield is also a very efficient lightning arrester, should lightning pass the regular protective devices.

As to protective devices for a small exchange, the ordinary porcelain block carbon and fuse arrester is cheaper than anything else and fully as efficient, provided it is properly fused, the only objection to it being that heavy fuses are sometimes substituted for the one-quarter ampere fuses that should always be used.

To return to the difficulties of rural telephony, the bumptiousness of certain farmers can be overcome only by constant efforts to educate them as to their own rights and the rights of others. It takes time to do this and to make them understand that they cannot hold the line for an hour, talking about a horse trade, when others wish to use the line. It would not be a bad idea at the start to make a rule that no one should use the line over fifteen minutes if anyone else desires connection. There should certainly be some way of checking the senseless gossip that is carried to interminable length on some rural lines. As to the curiosity of farmers and their families, that can only be overcome by a long process of education; but to prevent their interference with signalling it may be necessary to insert a german silver, or graphite, resistance of, say, 1,000 ohms in the loop to the receiver, which will generally check a too great flow of current through the induction coil and receiver, and allow of a fair degree of signalling. It should be impressed upon their minds that they are violating the law by listening to conversations not intended for them, and that every time the receiver comes off the hook they are exhausting their own batteries, whether they are talking or not. The following offers another solution: A good dry battery should last for a year. Why would it not be a good plan to have it understood that a new battery is expected to last for ten months, and make an extra charge for renewals if the battery should run down before that time? More care would be exercised about "listening in" if it were found that such interference was likely to cost something. Of course, this rule can be suspended where the batteries are found to be inherently defective.

Now, for the question as to whether such lines can be made to pay: A line six miles long, such as described above and serving even twenty telephones, will cost approximately $800, including its instruments. Such a line will last at least ten years without very extensive or costly repairs, so that the line depreciation may be computed at 10 per cent on $600, or $60 per year. Instrument depreciation will be somewhat greater, or about 15 per cent, which would be $30 on the remaining $200. Line troubles should be very small; battery renewals, about $1.00 for each instrument at this distance from town, and instrument troubles about the same. Fifty dollars should cover line, instrument and tree-trimming maintenance, so that the account stands about as follows:

Depreciation	$ 90
Maintainance	50
Total	$140

To the above account should possibly be added operator's services, about $60 a year, and also interest on the $800 at 10 per cent, making a total of $140 more, or $280 altogether as the actual cost of running the lines and service. This, however, will be offset to a certain extent by toll revenues. A rate of $1.25, therefore, would pay about the actual cost of operation, service and maintenance, giving a total rev-

enue of $300 a year from twenty subscribers. As this is only about $20 above the actual cost, it is a little too close a margin to provide against possible accidents, such as lightning, tornados or sleet storms. The charge should, therefore, be about $1.50 per month for each instrument in order to provide a reserve fund, and to apply on rents, salaries, light, heat and other incidentals.

In figuring the cost of pole lines a liberal estimate has been made for first-class work, which fully offsets the close figures on instruments. A small saving could be made by running out grounded instead of metallic circuits; but when we consider the cost of ground rods and the extra time required for the wireman to make a good ground connection and the general unreliability of such circuits, the saving on grounded lines is more apparent than real.

There is also less saving in the use of ten-party lines than is commonly imagined, unless it should happen that space on the switchboard is very scarce, but the extra work and worry thrown on the operating department fully offsets the slight saving in wire and drops.

A community of farmers may object to paying $18 a year for telephone service, but if they see a well-constructed line, a great deal better than they can build themselves, and become thoroughly convinced that its service can be relied upon at all hours of the day and night, they will be satisfied to pay the slightly additional sum required. What subscribers want is reliable service. Besides this, farmers, although sometimes slow, are generally reliable in the matter of payments.

(To be continued.)

Transposition and Relative Location of Power and Telephone Wires.*

By P. M. Lincoln.

(1) The extraordinary sensitiveness of the telephone receiver makes this instrument peculiarly susceptible to electrical disturbances. One authority states that the energy used in a 16 candle power incandescent lamp is sufficient to produce an audible sound in thirty billion receivers. The methods, therefore, of shielding telephone wires from the inductive effects of neighboring wires become important. Particularly is this true in the case of a telephone line paralleling a high tension transmission line, where the inductive disturbances are apt to be large and uninterrupted service on the telephone line important.

(2) The remarks and discussion in this "Introduction to Discussion" apply particularly to telephone lines paralleling high tension lines, but comments hereon need not be restricted to such cases.

(3) There are three ways in which disturbing current in telephone circuits may be caused by the high tension circuit.

(*a*) Electromagnetic induction.
(*b*) Electrostatic induction.
(*c*) Leakage.

It is the first two causes of disturbances which will claim particular attention in the following discussion.

(4) Electromagnetic induction may be briefly described as a transformer action. In Fig. 1 let *a*, *b* and *c* be the conductors of a three-phase line, and *m* and *n* the two wires of a paralleling telephone circuit; *a* and *b* may then be regarded as the primary and *m* and *n* as the secondary of a transformer. The EMF. in circuit *m n* will depend, among other things, upon the amount and frequency of the current in the inducing circuit. By transposing *m* and *n* in the well-known manner, the EMF.'s set up in one part of the telephone circuit will be neutralized by equal and opposite EMF.'s set up in other parts. Thus, the electromagnetic effects between *m* and *n* may be entirely neutralized by transposing the telephone wires only, regardless of whether the transmission wires are transposed or not. It may be well to note, however, that while the EMF. between the two telephone wires may be reduced to zero by properly transposing the telephone wires only, the EMF. between the two telephone conductors considered as one side of a circuit and the earth as the other, can be reduced to zero only by transposing the power wires. This point is of little importance, however, as any electromagnetic EMF. between the telephone wires and ground is entirely overshadowed by the electrostatic which will be considered later.

(5) Electrostatic effects will also take place in *m*, *n*, due to transmission circuit, *a*, *b*, *c*. If conductor *a* has a minus charge, for instance, it will induce a certain plus charge on *m* and a smaller plus charge on *n*, on account of *n's* greater distance from *a*. If now the minus charge be removed from *a*, current will flow from *m* to *n*, proportional to the difference in the amounts of these charges. The electrostatic influence of *b*, being opposite *a* in sign, will reinforce the action of *a*. Transposition of the telephone wires will have the effect of neutralizing this tendency of setting up electrostatic currents between *m* and *n*. It is important to note that a system of transpositions designed to correct electromagnetic induction between the wires will also be correct for electrostatic induction.

(6) Considering the comparative electromagnetic and electrostatic disturbances in a section of untransposed telephone line, it may be interesting to observe that the first is in the nature of a constant potential effect and the second of a constant current effect. It is evident that induced electromagnetic EMF. is constant as long as the inducing current is constant. As for the electrostatic effect, it is evident that the amounts of the induced charges on *m* and *n*, and therefore the electrostatically induced current between them, will not become appreciably reduced until the current flowing between *m* and *n* makes a difference of potential between them appreciable, compared with the inducing difference of potential. With telephone receivers of varying resistance, therefore, the ampere turns in the receiver due to electromagnetic induction are practically constant, while those due to electrostatic induction increase with number of turns and therefore the resistance of receiver. The electrostatic and electromagnetic effect become roughly equal with an arrangement shown in Fig. 1, when *a*, *b*, *c* is a line carrying 50 amperes at 20,000 volts, and the telephone circuit contains a total resistance of 1000 ohms, including receivers.

(7) The bridged telephone has almost universally taken the place of the series instrument for all telephone work. The series telephone is particularly objectionable for use on a circuit in which static induction takes place to any great extent. The reason for this is seen by an inspection of Fig. 2. The telephone wire *m* has between *A* and *B* a plus charge induced and between *B* and *C* a minus charge. There is, therefore, at the transposition point *B* a flow of current from one section of *m* to the other. If now a series

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telephone be placed in series with *m* at *B*, it not only gets the benefit of this charging current between the two sections of *m*, but it also creates a difference of potential and, therefore, disturbing currents in telephones at *A* and *C* as well.

(8) Although a proper system of transposition will prevent the establishment of an induced EMF. between the two

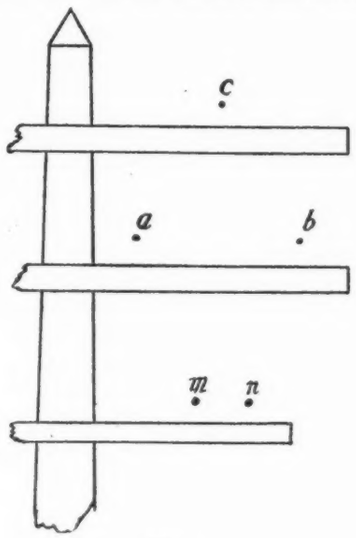

FIG. 1.

telephone wires, it does not necessarily prevent the two wires from assuming a potential which differs from that of the earth. In a properly transposed system, each telephone wire is the same average distance from each power wire. The potential, therefore, which the telephone system tends to assume from the static induction of the power wires is that of the neutral point of the power system. By neutral point is meant that point between which and each of the power wires the average EMF. is the same. Under normal conditions this neutral point is at ground potential. If, however, leakage takes place from one of the power conductors to ground, this neutral point will differ in potential

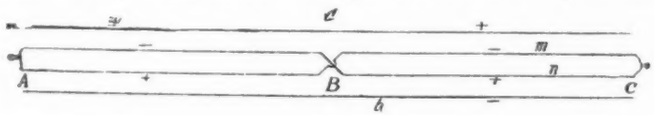

FIG. 2.

from the ground and the amount of this difference becomes greater as the resistance of the leak becomes less. In a three-phase system, when the resistance of this leak becomes zero, the maximum difference of potential between the neutral point and ground occurs, and is 58 per cent of the power circuit voltage. In a 20,000 volt system, for instance, there may exist a potential of nearly 12,000 volts between the neutral point and ground. When the neutral point of the power line differs in potential from the ground, an electrostatic difference of potential tends to exist between the telephone wires and earth, and will exist if the insulation of the telephone circuit is perfect.

(9) The amount of this electrostatic potential between the telepohne circuit and the earth will depend upon the relative capacities between power and telephone lines on one hand and between telephone line and earth on the other. The power and telephone lines may be considered as opposite plates of one condenser and the telephone line and ground as opposite plates of another condenser. These two condensers being in series they will distribute the total EMF. in inverse ratio to their capacities. With usual construction, the capacity between telephone line and ground will not be less than that between telephone and power wires, so that the potential of the telephone wires above ground will be equal to at least one-half the potential of the power line neutral point above ground. A grounded power line may thus cause a potential between the telephone wires and ground which will reach well into thousands of volts, and even a bad insulator may cause such an EMF. measured by hundreds of volts. In this connection it is significant to note that in the great majority of cases the telephones become inoperative when a ground occurs on the power lines. Is it any wonder? How many telephone lines are built to stand up under a strain of even 1000 volts, let alone 5000 or 10,000 volts to ground? It is hardly necessary to point out the path of the disturbing currents. The first voltage strain comes not between telephone wires, but between the two wires and ground. A breakdown of its insulation, either partial or complete, occurs at some point, and the wire to which the break occurs discharges to ground either partially or completely, and the other wire must discharge through the telephones to ground.

(10) The points, therefore, which deserve careful consideration in the installation and operation of a telephone line when it is to be operated in proximity to a high tension transmission line are the following:

(*a*) Insulation.
(*b*) Transpositions.
(c) Use of bridge telephones instead of series telephones.
(*d*) Making static capacity of telephone wires to ground as great as possible, and capacity to power wires as small as possible.

(*a*) Insulation.

(11) Insulation is put first as being the point of first importance. A ground on the transmission line is going to cause either volts or trouble on the telephone line. There is no reason why the telephone wire will not transmit speech properly, even if it does differ in potential from the ground. But to obtain this result, disturbing currents from the line to earth must be prevented by perfect insulation. When it is realized that the potential between the telephone line and ground may be as high as 30 per cent of the potential between power wires, the importance of insulation is better understood. By insulation, too, is meant the insulation throughout the entire line. There is little use in providing glass insulators for pole supports capable of standing a voltage of 15,000 or 20,000, and then inside buildings attaching the telephone wires directly to woodwork which may be damp, or to an instrument mounted on a damp brick wall. Above all, there is no use in putting up a line which may be able to stand a test of 15,000 or 20,000 volts, and then attach to this same line a lightning arrester which will break down at 300 volts, as the standard telephone lightning arrester is expected to do.

(12) When providing high tension insulation for the telephone line, the insulation of the man using it should not be forgotten. This insulation of the telephone user is advisable, not only to protect him from the induced voltage, but also to protect him in case of a cross with the power line. The induced voltage is not so dangerous as its amount would indicate, because the current is limited to that of a condenser consisting of power line, as one plate, and the telephone line as the other. It may be noted that the telephone insulation is subjected to high strains only when the power line is grounded or heavily unbalanced statically. This is just the time, however, that uninterrupted service of the telephone line is apt to be of the utmost importance.

(*b*) Transpositions.—

(13) The necessity of transposing the telephone line is almost so apparent as not to need comment. Otherwise continuous disturbances will exist, due both to electromagnetic and electrostatic effects. So far as the telephone line is concerned, transposition of the power wires is not so important. An untransposed power line cannot induce either

electrostatic or electromagnetic effects between two transposed telephone wires, but only between these two wires and ground. The amount the statically balanced untransposed power line can elevate the telephone wires above the ground potential is small compared to the effect of the power line when statically unbalanced, whether transposed or untransposed. If the telephone line is insulated to meet the worst conditions, it will be ample to meet the normal condition of an untransposed power line.

(*c*) Use of Bridge instead of Series Telephones.

(14) This point is one which need only be mentioned. The advantages of the bridged over the series telephone are so well known that the reason before mentioned for using a bridged instead of a series instrument is simply throwing another shovelful of earth on the grave of the series instrument.

(*d*) Making Capacity of Telephone Wires to Earth as Great as Possible, and Telephone Wires to Power Wires Small as Possible.

(15) In Montana there is a line in operation at 50,000 volts. Other lines are projected as high as 60,000 to 80,000 volts, and there is a possibility of going higher. When one realizes that with the usual construction, as shown in Fig. 1, there may be in such cases an elevation in the potential of the telephone wires of 20,000 to 25,000 volts above ground he begins to cast about for some method of reducing this potential. The total voltage between the neutral point of the power wires and ground may be considered as taken up across two condensers, one consisting of the power and telephone wires, and the other the telephone wires and earth. To decrease the possible potential of the telephone wires to ground, therefore, one must either decrease the capacity of the power wire, telephone wire condenser, or increase the capacity of the telephone wire, earth condenser, or both. This may be accomplished by increasing the distance between power and telephone wires, and decreasing the distance between telephone wires and earth. If the same supporting structure be used, there is a limit to which this can be carried, at which the possible voltage between telephone wires and earth may still be prohibitive. The capacity of the telephone wire-earth condenser may be still further increased by bringing the earth to the telephone wires, instead of the telephone wires to earth. That is, one more ground wires may be run in close proximity to the telephone wires, thereby increasing the capacity of the telephone wire-earth condenser, to almost any desired limit. By this means the possible potential between telephone wires and earth may be brought within limits where it may be taken care of with safety.

(16) In conclusion, the writer asks for the freest comments on the foregoing remarks, particularly from those who have had experience in operating a telephone line paralleling high tension wires. If such can agree with the writer in his remarks he will be pleased to know it. If they cannot agree, he will be still more pleased to find out wherein he is wrong.

Modern Telephone Service.*

By S. J. Larned.

If we classify all telephones as to the nature of the places in which they are located, the group of residence telephones will be the biggest. In Chicago over 20,000 families find a telephone at home worth while. With the men of the house, its principal value is to establish a link between house and office, putting the business man within reach in case of accident or emergency and often enabling him to stay at home, when without such a connection he would have to be on duty. In sickness he is not isolated and telephones are often placed at a bedside to allow some unfortunate to still conduct his business, though he may be on his back.

But to the real head of the home, the connection with the grocer and the butcher is the all-important one, and to the market men this business is so important that they have sometimes paid for telephones in the houses of their customers for the sake of getting it. In some cities, notably San Francisco, an extremely cheap service known as kitchen service has been established, and is much used. It is primarily intended for marketing, and the stipulation is made that the telephone must be located in the kitchen. It is a one-way party-line service, there being no bells placed on the instrument, and, as its name implies, is devoted to the stocking of the household larder. Emergency calls for fire or police protection, or for the doctor, are not as frequent as the market and social calls, but perhaps count for about as much in importance. Probably more than half of the fires in most large cities are reported by telephone.

Ingenious householders have found innumerable other uses for the telephone never originally thought of. The operator many times gets the request, "Please ring my bell at 6 o'clock to-morrow morning"; 5,000 times every day in Chicago she is asked for the time of day; election and prize fight results, football and baseball scores are asked for and reported.

Many attempts have been made to allow telephone patrons to listen to operas, concerts and church services, but without any permanent success. I have heard of people taking French and German lessons over the telephone.

In no other class of service are the demands and uses as varied as in the residence service. In exchanges where they predominate, the load line is very different from the more purely business exchanges, and it indicates in a way the habits of the inhabitants. The load comes on earlier and the maximum demand comes at marketing time, about 9 a. m., and then falls off and continues at a pretty uniform rate till late in the evening. A little spurt is noticeable at about 5 p. m., when the man of the house calls up from the office to explain why he cannot come home to dinner, or to announce that he is bringing four or five friends with him.

The majority of residence telephones are connected up on party-lines, their light traffic hardly requiring the exclusive use of a pair of wires for each one.

Closely allied to the residence service is the system now becoming popular in most of the large hotels. A private switchboard is set up in the hotel with a telephone connection to every room and trunks to the city exchanges. The newly arrived guest in his very bedroom at once becomes a part of the great telephone community, one of the get-at-able people of the city, and is presented with the keys of the city more really and effectually than were ever old-time heroes who were honored by that interesting old ceremony.

To the merchants, big and little, the telephone is the doorway through which a large portion of their customers enter; with some by far the biggest part of their trade comes to them over the wire. Gradually they have all come to appreciate the importance of this bond of union with the

*Paper read before the Chicago Electrical Association on March 20, 1903, by S. J. Larned.

outside world. Many who, a few years ago, allowed their customers to jam and push one another in their efforts to get to them over one crowded telephone line now advertise with great prominence the special facilities they have provided for such business, with clerks who devote their entire time to telephone orders. Those who carry small stocks depend upon it entirely for replenishing in case of sudden calls.

In the offices of the various professional men, lawyers, physicians, etc., the use and dependence upon the telephone is nearly as great. The doctors, of course, are slaves of the telephone, being always at the beck and call of their patients. For their special behoof a form of portable telephone has been devised that can be carried from room to room, so that eating, sleeping or in his office, the doctor may always have his telephone at hand.

The big corportaions would hardly be a possibility without the telephone system, which bring all their multitudinous heads and branches within talking distance of one another. Were they to be made dependent once more on old-time methods of intercommunication, they would break up into smaller, simpler parts.

One of the vital organs of their being is the private telephone exchange; designed primarily to afford quick intercourse between the individuals within the organization, it has become also a clearing house for most of their transactions with the outer world.

In construction, a private exchange is simply a general exchange in miniature, though when one considers the private exchanges that serve the large railroads and packers, or a store like Marshall Field's, the term miniature is perhaps inappropriate.

The relations of a private operator to the people she looks after are direct and personal. She must know each man's name and part in the organization, and be able to connect inquiring strangers to the proper person. She must know who is to be allowed to speak to the august head of the establishment and who must be satisfied with the ear of someone lower in the line.

She must know the office habits of all her people, where they are to be found at any hour of the day. She gets to know their voices, their dispositions, the numbers they generally call; she is a confidential telephone clerk to the entire establishment, and a calamity overwhelms the place when she marries the bookkeeper, and a new operator has to slowly learn the ropes.

Private exchanges and private operators are by no means confined to the giants in business. Wherever a business gets beyond the one-man state, there is a field for the private operator, and that form of service is rapidly growing in popularity. In New York City the number of private operators by far exceeds the operators employed in the central exchanges.

Most telephone men feel that the general tendency of the demand to-day is for a more personal service, rather than for a self-operated mechanical device, however well designed. The busy man prefers to have a professional attendant to operate for him the machinery that he uses, whether it be a typewriter, an elevator, a street-car or a telephone switchboard. Conductorless street-cars have never been popular, and I doubt whether operatorless switchboards will ever be more so. I do not mean that I disbelieve in mechanical appliances, calculated to increase the working range of any individual. We can say with certainty that in the future operators will do more and more of their work through the use of just such appliances, but ideal service will still require the interposition of a trained operator between the general user and the wonderful, intricate machinery of a telephone exchange.

Ideal service, though it can never be quite attained, is the ambition of the operating department of a telephone company. People may differ as to the essentials of good service, but I will venture to set down the following points as, in my opinion, most vital from the users' point of view:

The exchange should include as patrons every one with whom one might wish to converse.

Calls should receive uniformly prompt response from the operator.

Connection with the person or telephone called for should be made rapidly and accurately and should not be interrupted.

Communication should not be prevented by busy lines.

Communication should not be interfered with by the apparatus getting out of order, or if such trouble does occur, it should be promptly remedied.

And last, but not least, the treatment of patrons by employes should be courteous. The converse of this is true, but is not so easily controlled by the telephone management.

The requirements are ideal and service is good if it only approximates them closely.

It is sometimes stated that the installation in Chicago of a vast number of telephones at low rates on party lines has been unfair to the larger users of the service; that it has, perhaps, been a boon to the small users who could not afford a better service, but that the others suffered, drowned as it were in the ocean to which their little pool had suddenly grown.

But this is not an age in which people, business people at least, care to limit their intercourse to a small and select circle. The telephone aristocracy, if I may call it such, has suffered in the way a newspaper would suffer if its readers were doubled; or as a retail store would suffer if increased multitudes were brought to its doors each day.

The service is most often gauged by the way in which calls are answered by the operator, by the promptness with which she responds and by her general bearing and attention and courtesy.

The standard of service generally set requires that the time of answering, i. e., the interval between the picking up of the telephone and the response of the operator, should not average more than six or seven seconds. But a good average alone is not sufficient. A user may have been answered in three seconds on twenty consecutive calls, but he is apt to forget that part of it if on the twenty-first call he has to wait a minute.

The answering must then be uniform. The generally accepted standard on this point is that from 90 to 95 per cent of all the calls must be answered in less than 10 seconds. The uniformity of the service is affected principally by the nature of the operator's work. The two factors determining the load upon her are the number of calls she has to answer and the operations or talking required to dispose of each call. The service is bettered very much more by decreasing the second factor than the first. As a matter of fact, every one of us is more alert and active, and accomplishes things with less effort when he is busy and pushed than when things are not coming his way rapidly, and if we decrease the number of calls that an operator has to answer, and give her time to lean back and fold her hands between calls, her attention is sure to lag. But by paring down unnecessary phrases that she uses, by machinery to cut out certain manual operations, by providing easily read signals to keep her posted on various phases of the connection, the amount of time that she must give to each call is so reduced that even though she receives simultaneous calls from three or four patrons, each one can be answered with reasonable promptness.

The work of an operator is not easy, and the requirements of a good operator are many. She must have a good voice and a quick ear; she must be alert, active, even-tempered and adaptable, for though one moment she may be hearing the complaints of a man to whom she has just had to report a line busy for the fifth or sixth time, she must turn

instantly, perhaps, to answer a lady to whom her voice must show no trace of impatience.

Her first learned and most often reiterated rule must be one of patience and courtesy. The most rigid discipline, of course, must be insisted upon, for inattention follows the least appearance of a free and easy spirit. Plenty of calls to answer is the greatest aid to good discipline, for the old saw that couples up Satan and mischief and idle hands, is as true of telephone operators as of the rest of mankind. Besides this, a military system of responsibility is carried out, the operators being divided into small groups of nine or ten, each captained by a supervisor, who, in turn, is responsible to a chief operator.

Though an operator is required to concentrate her whole attention on her work while on duty, she is given frequent resting spells throughout the day in comfortable rooms provided for that purpose in each office, so that the work is not, on the whole, trying.

The applicants for positions are always in excess of the needs, and the successful ones are selected by examinations. This provides the raw material for an operating force, composed for the most, the best part generally, of young Irish-American girls. Weeks and months of patient teaching and practice are needed to round them into form, and after a couple of years' service matrimony claims them, and new recruits must be trained for their places.

Courteous treatment of patrons by employes, and vice versa, are, without question, things of which the exchange management must take cognizance; but perhaps the treatment of patrons by patrons is nearly always their own affair. Nevertheless, I want to voice a protest against a growing habit which is, I think, the grossest kind of an imposition upon the victim of it.

Mr. Brown wishing to talk to Mr. Jones, tells his office boy to get Mr. Jones on the telephone. Mr. Jones is called, perhaps taken away from important work, and when he gets to the telephone, instead of finding Mr. Brown ready to talk, is told to wait a minute—Mr. Brown wishes to speak to him. My own practice on receiving such a call is promptly to hang up my telephone, instead of waiting, and get what little satisfaction I can out of the knowledge that Mr. Brown is also wasting a little of his time. If I ring my neighbor's door-bell I expect to be considerate enough of his convenience to be at his door when he opens it, and do not send a small boy to ring it a minute or two in advance of my arrival.

The most frequent complaint, and least often deserved, that the exchange manager hears, is that of false busy reports. While too frequent busy reports are a decided defect in service, it is one only in a small measure controllable by the telephone management. The only remedy is a campaign of education among those insufficiently provided with telephones. But they can never be eliminated. In Chicago, about one call in five is unsuccessful because of a busy line.

Telephone men have adopted the railroad use of the word "traffic," to describe the amount of business, the number of telephone calls or conversations carried on in a fixed time. Traffic counts are made at frequent intervals on particular lines or in total, to point out overloaded or underloaded lines, or operators, or exchanges. These counts show in Chicago a total of more than two-thirds of a million conversations per day.

Faults in the service, due to defects in the apparatus and lines, are, unfortunately, always numerous, and the maintenance force of an exchange is always a large and busy one. Of the millions upon millions of parts comprising the machinery of the Chicago exchange, it is small wonder that a thousand or more go wrong in the course of every day.

In various ways the knowledge of the mishap filters through to the repair department; some cases are discovered by the operators, others reported by the subscribers. They must first be diagnosed by the tester, whose work in many respects is analogous to that of the family physician. He first inquires as to the symptoms, thumps the patient two or three times with positive or negative or alternating current, listens to his voice and decides, too often perhaps, that the ills complained of are imaginary.

But having discovered an actual trouble, he turns it over to the proper specialist—the switchboard man, the underground man, or the line and instrument repairman. The work of these men must be checked and carefully tested after the trouble is cleared. Accurate reports as to the nature of the trouble are made and tabulated, so as to indicate prevailing difficulties and point out unreliable types of apparatus. The interval of time between the reporting and the clearing of the trouble is also noted and tabulated.

The value of all such data, of course, is in pointing out definite lines along which improvement may be made and preventing a self-satisfied assurance that conditions are good enough as they are.

Every business house must keep posted as to the quality of the stuff it is selling to the public, and a telephone company must go to particular pains to discover the real facts as to the kind of service it is rendering. It might be supposed that its patrons could be depended upon for such information, but, as a matter of fact, about 98 per cent of them take everything for granted, and make absolutely no expression of satisfaction or dissatisfaction. Of the remainder, a few report such difficulties as they may encounter from time to time; another few apparently never encounter anything but abuse or lack of attention from the incompetent and idle employes of the company. Another very much smaller lot will occasionally give a word of commendation.

In order, therefore, that the record shall not be entirely blank or black, the telephone company is obliged to learn for itself what is being served out to the public. So a considerable force of men and girls is constantly at work making hundreds of test calls of every description daily, or standing, stop-watch in hand, beside patrons who are making calls, timing the answering, noting errors, busy reports, etc., and the thousand and one details of the service.

These results regularly tabulated are a fair index of the general trend of things. A relaxation of the discipline in any office, due perhaps to an inefficient manager or chief operator, is very soon indicated by the tabulated tests.

To the telephone man it sometimes seems as if all the pent-up impatience of humanity finds outlet at the telephone.

This is due, I think, to the impossibility of seeing and knowing all the attendant circumstances. We send a call out over the wires for a friend, and cannot follow it through all the intricacies of wire, cable, switchboard, etc. It is easy to imagine if anything goes astray that some malevolent power at Central is thwarting us. It is no unusual thing for a man to work himself into a passion over an inanimate piece of wire that has unfortunately broken, and attribute all of his troubles to the spiteful operator.

Perfect telephone service, that is, service in which each one always gets what he wants and gets it quick, is as impossible as in any other field of human effort, for we are dealing with a machine more complicated and with a greater number of parts than any other in existence. Moreover, the parts are distributed all over the land, tied together by mere threads of copper, exposed to the disturbing influences of mankind and the elements, and dependent for good working upon the proper co-operation of everyone concerned, from you who originate a call down to the irresponsible office boy or ignorant domestic who may answer it.

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Advantages of the Common Battery Telephone Switchboard.*

By S. P. Grace.

Mr. Lockwood, in his paper on the evolution of the telephone switchboard, has admirably described the manner in which the present perfected arrangement of switchboards developed from the crude switching devices of the early days of the telephone. Mr. Lockwood has also given a very complete description of a modern common-battery telephone switchboard, and has also shown and described the line of investigation which was pursued to attain this development. It is not necessary for me to add anything more on the evolution of the telephone switchboard, since Mr. Lockwood has covered this matter in such an admirable manner; so I shall simply call attention to a few of the great advantages that the common-battery system possesses.

We may subdivide the advantages accruing from the common-battery system into three general heads:

First—Improvements in operating.
Second—Economy of maintenance.
Third—Quality of service.

In discussing the question of operating, it is perhaps instructive to look back and see the difficulties under which the operator worked under the old arrangement of magnetic switchboards. The switchboard was arranged with a large number of annunciators or drops mounted on the face of the switchboard near the top. When a subscriber turned the crank at his telephone his annunciator was displayed in front of the operator, who had to look up at the annunciator, ascertain its number, and then hunt out the corresponding jack in which to plug. This kept the telephone operator's head tilted upward at an awkward and disagreeable angle.,

In the common-battery system the subscriber merely removes the receiver from the hook, which act lights a small incandescent lamp immediately adjacent to the answering jack belonging to the calling subscriber. The operator in answering does not have to ascertain the particular number calling, but merely "plugs out" the light. This act alone increases the speed of operating from three to four seconds.

Another great disadvantage of the magneto system was the entire absence of supervisory signals, i. e., the operator had no means of knowing when the calling or called subscriber was at the telephone. The only arrangement for disconnecting was a clearing-out drop bridged across the cord circuit. It was necessary for the subscriber to ring off when through using the line.

Undoubtedly, many of you have run across the sign painted in large letters on the telephone, "Ring off." But it is human nature to do as little as possible when once you receive the benefit you asked for; so, while all the subscribers would ring in to get central, but a very small percentage of them would remember the injunction to "ring off."

In the common-battery system there is placed a supervisory-lamp signal on each side of the cord circuit, which is used to connect together two subscribers' lines. When a subscriber is rung by the operator, one of these lamps remains lighted until he answers. When both subscribers are finished with the conversation the simple act of hanging the receiver upon the hook lights both of these supervisory lamps, which is a signal to the operator that that pair of cords, and consequently the connected lines, are no longer in use. She will therefore immediately remove the connection. If either one of the subscribers wishes to call in the operator during the course of a connection it can be done by simply working the hook up and down, which flashes the supervisory signal. It is thus seen that for all local connections the operator has complete supervision over the calls.

It is, however, in a multiple-office district, such as Pittsburg, where the advantages of the common-battery system are particularly in evidence. In such a district it is necessary to operate a number of offices and arrange for trunking connections between them.

In the magneto system there were provided no supervisory or disconnect signals on these trunk lines. This made the operation of them extremely difficult and also impaired the quality of the service rendered, since the operators would frequently make mistakes and take down the connection before the conversation was finished.

In the modern common-battery system, when a call is received for a line in a distant office the operator who receives the call cuts in directly on what is known as a calling-circuit wire to an operator who is located at the exchange which contains the line asked for. This operator assigns a trunk to be used and at the same time plugs the trunk which ends in a plug and cord into the line asked for. The originating operator, of course, plugs into the other end of the trunk line. When both subscribers are through talking the disconnect signals are received by the originating operator in the usual manner, who will take down the connection. The taking of the plug out of the trunk line automatically gives the trunk operator at the distant exchange a disconnect signal to show her that the trunk line is no longer in use. She will then remove the trunk line from the local subscriber's line. Similar automatic trunks are provided for use between the local boards and the long-distance boards. It will thus be seen that, from an operating standpoint, the common-battery system removes the necessity of the personal supervision of calls by the operator, automatic signals being the means of warning her of all stages of the connection.

The common-battery system also enables us to increase the operator's load, which means that an operator can answer more telephones than in the old-style systems. Our payrolls show that with a first-class common-battery system we can handle the same business with about 20 per cent less operators. The common-battery system is therefore easier and cheaper to operate than the old-style system.

Let us now consider economy of maintenance. In the old-style systems each individual telephone was a small edition of a central-office power plant. We provided batteries for furnishing the direct transmitter current and a complicated magneto generator for furnishing alternating current for signaling the central office.

Anyone who has had experience in the maintenance of even a small central-office power plant will recognize the difficulty and the expense of maintaining these thousands of isolated power plants which were located in each telephone. The maintenance of this generating outfit cost from $2 to $3 a year a telephone. But in the common battery system, all these isolated power plants are done away with, and a single central-office power plant suffices for the entire exchange. One large storage battery, consisting of 11 cells, is installed. This main battery is charged from motor-generators from off the lighting mains, and supplies all

*A paper read before the Pittsburg section of the American Institute of Electrical Engineers by S. P. Grace.

the current used in the telephone exchange. The cost of all current supply per telephone, including the fixed charges, probably does not exceed $1 a telephone a year in a modern common-battery system. The removal of the generators and batteries from the instrument has also cheapened its first cost and maintenance, and the instrument as it exists to-day contains the smallest possible number of parts.

It might be well to remark at this juncture that the successful operation of the common-battery system depended upon the evolution of the storage battery. We had to have at the central office a source of current of constant electromotive force, and which possessed practically no internal resistance. If the source of power were not constant or contained any internal resistance, all the lines connected with the exchange would be noisy or would have cross-talk on them. As is well known, the modern storage battery produces a current of constant electromotive force, and it besides possesses a very low internal resistance, these two features making possible the common-battery system of to-day.

In the common-battery system there is a pressure of 24 volts on every line all the time, and any poor or defective insulation will cause a leak of current and consequently the display of the signaling apparatus at the central office.

One of the great objections to the use of common battery by telephone engineers was the fact that it required superior outside-line construction, but this in reality has been a benefit, for with the common-battery system we must put our wires and cables underground and use as little open wire as possible in order to procure a good quality of service. Also the current being upon the lines at all times, it acts as a sort of watch dog to the entire system, and makes those in charge of the plant keep it in good repair.

From the above statement the economy of maintenance of the common-battery system is plainly apparent.

Turning now to the quality of service, we note that from the subscriber's point of view the common-battery system is eminently satisfactory. He is not required to grind a crank in order to signal central. All he has to do is to remove the telephone from the hook, which immediately displays the signal in front of the operator. This gives the subscriber practically nothing to do and transfers all work to the central office, where it can be taken care of by skilled operators. It is always possible for the subscriber to call in the operator by moving the hook, and the possibility of his being hung up and unable to get the central office is very remote.

That the subscriber is satisfied with the common-battery system is evidenced from the fact that in ordering a telephone or a private-branch exchange he will always tell you "that he wants that system where you take the receiver off the hook and it lights one of those little lamps."

I have stated above that in the old systems batteries were provided for each telephone for supplying the transmitter with current. When these batteries were new and in good condition, the service from the telephone was good, but after they had been used for a short time or if the subscriber accidentally left the receiver off the hook and thus allowed the batteries to run down, the transmission from the telephone would be very poor. Therefore, from the magneto system with local batteries, we never could hope to obtain a uniform grade of service.

It is highly necessary that all of the instruments talk well over both local and long-distance lines, for it is our aim and ambition to produce a satisfactory volume of transmission between any telephones in the entire country. In the local-battery system, if we spent a large amount of money in battery maintenance and kept the batteries in first-class order, the transmission for all local connections would be entirely too strong, although it must be admitted that it would be excellent for the long-distance connections. In the common-battery system the source of current supply is from the central-office battery, and we can therefore regulate the amount of current for each connection; i. e., for all local service we will have our apparatus so wired that the instrument receives sufficient current for local transmission, but when a long-distance connection is put up we will triple or quadruple the amount of current given to the transmitter. Thus with the common-battery system, we are enabled to give an absolutely uniform grade of transmission for all local connections, and for long-distance connections we can give the transmitter the ultimate amount of battery power that it will stand. This, in my opinion, is one of the most important advantages of the common-battery system.

So successful has the common-battery system proved in large exchanges that it is now our intention to carry the work still further and make even the smallest exchanges in country towns work on the common-battery basis. We have plans prepared for a number of these small exchanges which will work on the common-battery basis, but which will be provided with no power plant. The necessary current for operating the transmitters and signals will be supplied over from 10 to 30 miles of toll line from the nearest large common-battery plant.

We have also been successful in operating toll-station lines of from 20 to 40 miles in length and equipped with from five to ten stations on the common-battery basis.

In conclusion, at the risk of being considered too optimistic in my views, I will say that within the next ten years the local-battery magneto-telephone instrument, with its associated magneto switchboard, will be considered as a rarity in the United States.

TO CHECK SLOT MACHINE THEFTS.

A new device to protect telephone slot machines from being robbed is to be attached to the many boxes throughout Chicago by the Chicago Telephone Company. The boxes are said to have been broken into and robbed of their nickels at such an alarming rate that the officers of the company consider drastic measures for protection imperative. It is reported that one man alone secured more than $100 a day until he was caught and punished.

To make slot machines as near burglar proof as possible a seal resembling that used on huge freight cars is to be adopted. It will be of the best mechanism, and any tampering with the box will be quickly discovered through its use.

As there are 40,000 slot machines in use in the city, and as experimenting with seals will be required, it may be many weeks before they are put into general use. They will be put in place in various sections, however, and as the outward appearance of the box does not give an intimation of the existence of the new seal the vocation of the slot machine thief hereafter will be perilous.

Another protection for patrons and company against impostors is the new system of identification and credentials adopted for repair men, or collectors, authorized to examine the telephone mechanism. Every repairman is now compelled to carry a photograph of himself for identification by the patron, together with other credentials. The collectors are also supplied with credentials to satisfy patrons that they have a right to unlock the money box. Patrons have been requested by the company to demand and see such credentials before allowing any one to tamper with the telephone slot machines or wires.

Teacher (of juvenile class)—"Can any one tell me what a storage battery is?"

Small Tommy—"Yes, ma'am. Something that batters up furniture that's in storage."—*Exchange.*

Lodge-Muirhead System of Wireless Telegraphy.

H. C. FYFE, in Scientific American.

Through the courtesy of Sir Oliver Lodge and Dr. Alexander Muirhead I was enabled the other day to inspect the working of the Elmer's End to Downe wireless telegraph installation in Kent. For some years past experiments have been carried out quietly in a shed at Elmer's End, adjoining the works of Messrs. Muirhead & Co., and also in another shed situated at Downe, some eight miles away.

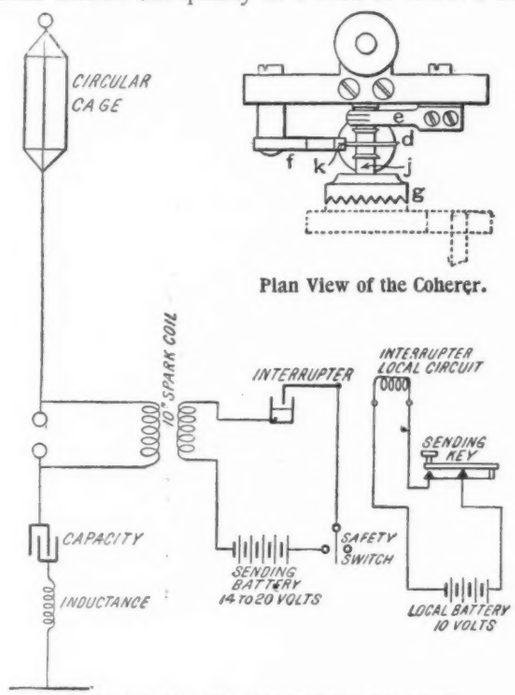
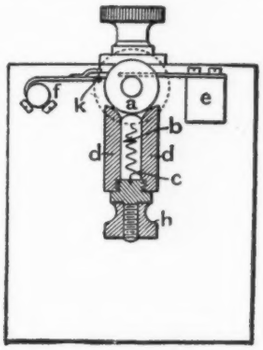


DIAGRAM OF THE RECEIVING STATION.

Plan View of the Coherer.

Between these two stations signals have been exchanged for a considerable period, but it was only quite recently that the inventors were sufficiently satisfied with their system to bring it before the notice of the cable companies. After a searching series of trials, the experts of the Eastern Extension Australasia and China Telegraph Company reported favorably on the new method, and as a result Lodge-Muirhead wireless telegraph installations have been sent out on the two new cable ships "Restorer" and "Patrol," belonging to the above-mentioned company, which have recently been dispatched to lay the new cable ordered by the Dutch government for use between Balikpapae, in Borneo, and Metado in the Celebes.



Vertical Section Showing Coherer Details.

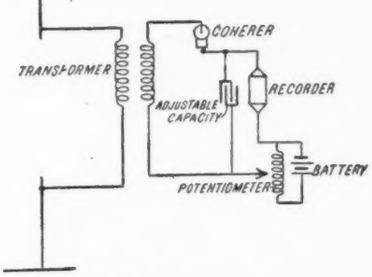
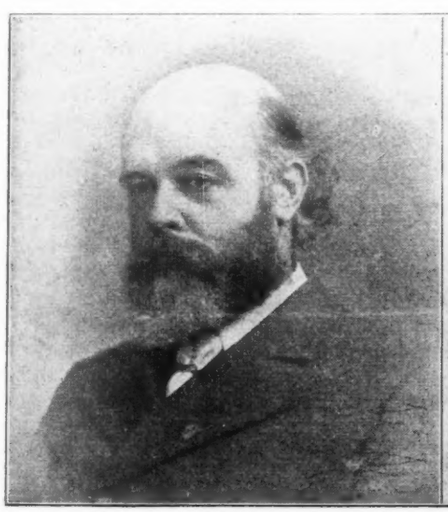


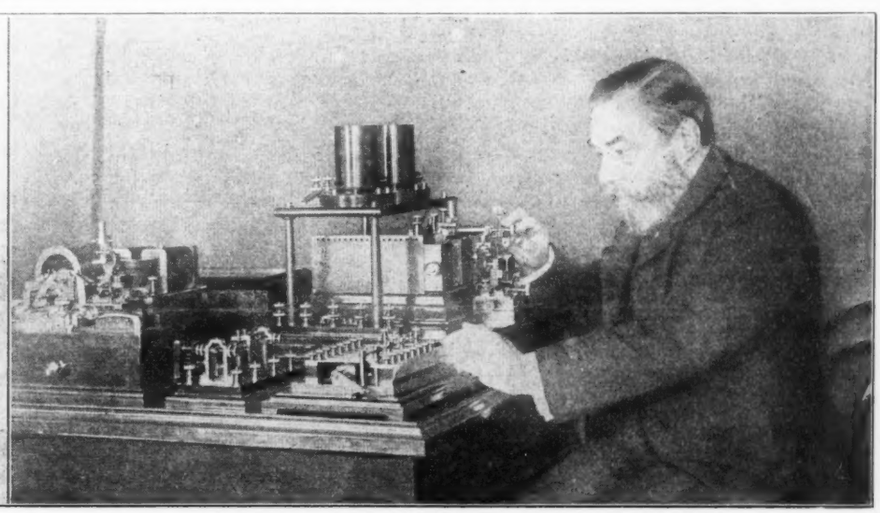
Diagram of the Sending Station.

This, it may be noted, is the first commercial application of the new system which we propose now to describe.

The Lodge-Muirhead receiver consists of a small fine-edged steel disk which is kept rotating by clock-work on a



SIR OLIVER LODGE.



DR. MUIRHEAD ADJUSTING THE DELICATE COHERER.

globule of mercury, from which it is separated by a thin film of oil. The construction of the receiver may be better understood by reference to the detail views, in which the disk is designated by the letter *a*. The mercury, *b*, is contained in a cup, *d*. Electrical connection is made therewith through binding screw, *h*, and the platinum wire, *c*. A copper brush which bears on the shaft, *j*, communicates current to the disk, *a*. A small cushion of felt, *k*, held in a spring support, *f*, serves to keep the edge of the disk clean. The disk is coupled to a clock mechanism by the ebonite clutch, *g*. The film of oil which covers the mercury acts as an insulator and prevents the passing of the current in the local circuit. The effect of the oscillations sent out from the transmitting station is to break down the firm of oil which covers the mercury and to establish contact between the disk and the mercury, thus completing the circuit of the receiving instrument. No tapper is required, as the coherer automatically decoheres, and no relay is needed, as the current is quite strong enough to work the Muirhead siphon recorder; the clockwork draws the slip on which the signals are pivoted, as well as driving the disk.

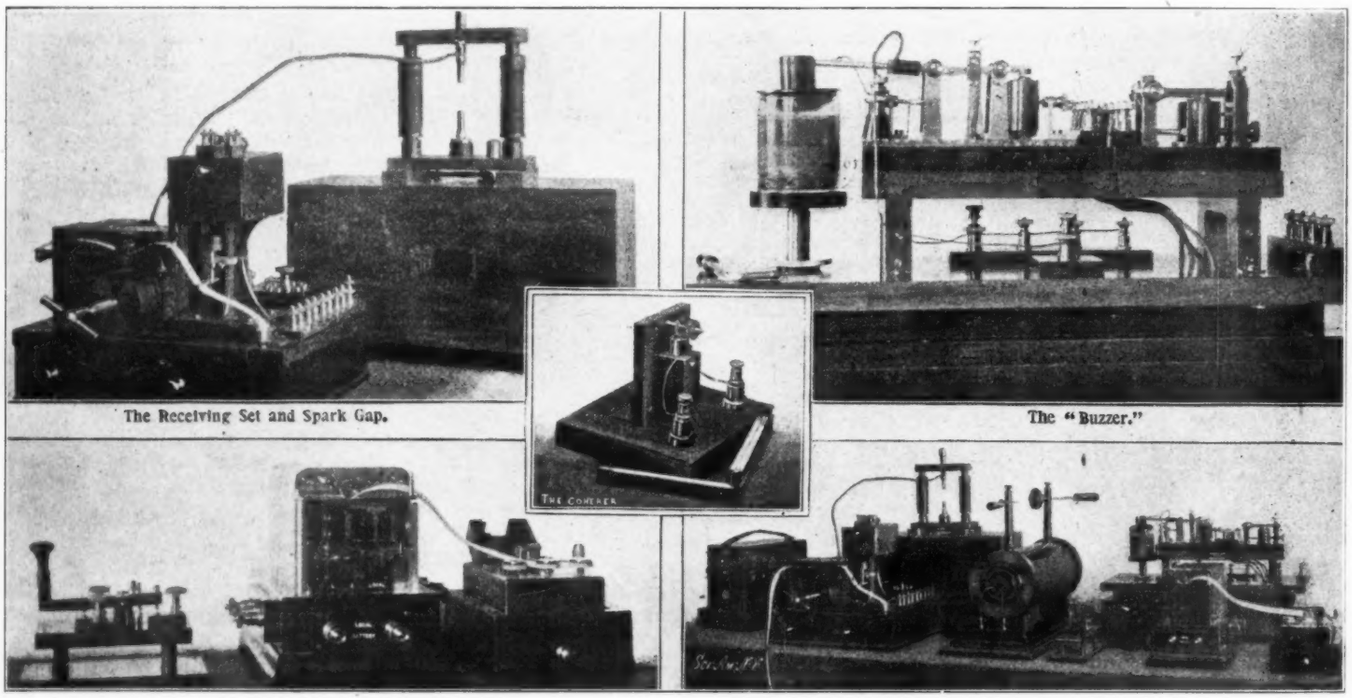
The plan of the receiving station can be seen in one of our diagrams. The vertical wire used at the Elmer's End station is 80 feet high, and on it is hung a light wire cage or capacity; an increase in the size of the capacity is necessary when larger distances require to be bridged for wireless communication. The cage is made up of four copper wires strung on to wooden loops with a copper ball above. One end of the wire is led through a capacity and inductance, and is connected up to the shed itself instead of being earthed. The other is led through the secondary coil of the transformer to the coherer.

The current passing through the coherer is led through an adjustable capacity to the Muirhead siphon recorder. The remaining apparatus at the receiving station comprises a local battery and a potentiometer to regulate the potential of the coherer. The employment of a transformer in the receiving circuit was one of Sir Oliver Lodge's earliest improvements and one which is made use of by Marconi in all his long distance work.

The apparatus employed in the transmitting set consists of a local battery of 10 volts, a sending key and an interrupter for the local circuit. The sending battery may have a voltage of from 14 to 20. A novel feature is the use of a "buzzer," viz., a couple of telegraphic sounders acting reciprocally, which operate a mercury make and break for the 10-inch spark coil. To one of the sounders is attached an aluminium needle dipping into the mercury. This forms a uniform and easily adjustable interrupter for the induction coil, allows the operator to have perfect control of the sparking frequency, and also does away with the possibility of his receiving shocks, which are liable to occur when the primary of the induction coil is directly broken by the key. After passing through the coil the current is led to two small brass rods between the ends of which sparking takes place.

Sir Oliver Lodge, F. R. S., the principal of Birmingham University, has been experimenting with Hertzian waves for a great many years past. On February 24, 1899, he delivered a lecture on coherers at the Royal Institution. A coherer was defined as an instrument which responds to electric waves somewhat in the same manner as a microphone responds to sound waves. Many different forms of coherer were shown, but no mention was made of the steel disk rotating on mercury, as this had not been discovered at the time. On June 1, 1894, Dr. Lodge delivered a lecture at the Royal Institution on "The Work of Hertz," and showed for the first time in England that electric Hertzian waves could be detected by means of suitable receivers through walls and closed doors, when set up by a transmitting or exciting apparatus some hundreds of yards away. In 1897 Mr. Marconi arrived in England with his system, and though Sir Oliver Lodge has kept his results secret until now, he has been working on the subject ever since his lecture in 1894. His first trials were over distances of 40 yards, and now the Lodge-Muirhead system has been operated perfectly at distances of 60 miles. The system was temporarily installed between Holyhead, in the Isle of Anglesea, and Howth, in Ireland.

"God Save the King" was the message that passed hundreds of times between the transmitting and receiving stations.



The Receiving Set and Spark Gap.

The "Buzzer."

THE AUTOMATIC TRANSMITTER WITH PERFORATOR.

COMPLETE STATION, COMPRISING TRANSMITTER AND RECEIVING SETS.

It may be noted that the Cunard liners using the Marconi apparatus often intercepted the signals. The inventors are now working on the question of tuning or syntonization, and they have succeeded in tuning the oscillations passing between two stations so that only the properly tuned receiver shall respond to its own special transmitter.

They are of opinion that their devices, which I am not at present at liberty to make public, will neutralize the interference from any station not less than ten miles distant, and will also prevent their signals from being read by any other station the same distance away.

The eight-mile Elmer's End to Downe circuit is a very difficult one, owing to the intervening hills, and it would correspond to a sea circuit of quite 60 miles.

During a voyage of the Liverpool steamship "Vedamore" across the Atlantic, signals were exchanged between the ships and the shore over considerable distances, and the system was also tried with success between Washington and Baltimore, a distance of 45 miles. The actual distance which can be covered is of course mainly a question of electric power.

The fact that the cable companies, which have never one of them adopted the Marconi system, have approved the Lodge-Muirhead system and are installing it on their cable ships is a splendid testimonial for the new method.

The telegraphic experts have not been satisfied with the filing-tube coherer used by Mr. Marconi. At every Marconi station it is customary to have on hand some thirty or forty of these tubes, as they have a mysterious habit of getting out of order, and it is impossible often to get them to receive signals at all. Possibly the continuous tapping has something to do with the lack of reliability of the filing-tube coherer; we have seen that in the Lodge-Muirhead receiver no tapping action is necessary.

Sir Oliver Lodge and Dr. Muirhead believe that they have got a system which will work regularly and without a hitch in all weathers; the coherer employed is regular and simple in action and quite easy to adjust, for it can be taken to pieces in a few seconds and any defects can be easily removed.

It may be mentioned that the disk coherer prefers long and slow oscillations to the sharp discharges which other coherers require, and the former are more convenient to work, especially in long-distance transmission. It is so sensitive that a long stroke or dash of the Morse code reveals the actual rate of sparking by the slight quivering of the line. The record on the tape is strong and clear and quite equal to the best submarine cable working.

Among other new features in the Lodge-Muirhead system, mention should be made of an automatic device for short-circuiting the coherer when the vertical wire is switched on to the transmitter, which obivates the necessity of burying it in a sealed metal case. Another new feature is the application of an ordinary automatic signaling machine to the sender, so that the message can be delivered perfectly spaced from a perforated tape, as in the British postoffice machines.

SOME ACTIONS OF AN ELECTRICALLY DISTURBED TRUNK LEAD.

J. C. KELSEY.

When two cities are close together they are sometimes connected in a telephone sense by a number of wires, called a trunk lead. When business becomes too great in one city for one exchange to handle, a branch exchange is built and is connected also by a trunk lead. These trunk lines are of a metallic nature and terminate in a plug in one exchange and a jack in the other exchange, and vice versa. They act simply as a temporary connection for two subscribers of different exchanges. As all exchanges are near congested districts, the trunk leads take the shortest route between them, which is sometimes the same as that of the street railway. They, too, connect congested districts and take the shortest route, and the trolley and the trunk lead very frequently parallel each other for one, two and often ten miles. So the first part of the telephone systems to feel the inductive and leakage troubles due to the street railway are the trunk lines connecting exchanges. In many old exchanges, therefore, the trunk lines were made metallic long before the newer systems came in on a metallic basis.

The older telephone company clings to the old right of way, and, as a matter of course, has its trunk wires exposed to the inductive effects of many miles of the paralleling trolley. Consequently it has extremely noisy trunk leads. If they are quiet it is because the line has been stifled and cut down at the expense of transmission. The newer companies have had to select a more roundabout path, not following the trolley lines, and have more satisfactory trunks and do not have to be so careful of switching conditions, with the result that, as a rule, they have better trunks, affording better transmission.

The old company may cut in transpositions that quiet the line in a measure, and this they do, and do it often, even on every pole, and the trunk is still inclined to be noisy, because under such powerful inductive conditions the balancing of a line is purely accidental. This means that the *exact* balance is accidental. A line that is apparently balanced under ordinary conditions may show weakness when paralleled by the trolley for ten miles, or even less. A line is balanced when both sides of it are exactly equal in resistance. If a line had one side with a resistance of 150 ohms and the other of 155 ohms, an unbalance will exist which will forbid absolute quiet, even if the line is transposed at every pole. The side with the least resistance will induce a greater charge than the side of the line with the greater resistance. It is like a transformer with two secondary windings, one with twenty turns and the other with twenty-five. These unequal charges are trying to neutralize each other, and they flow together through the split windings of the receiver, which is bridged across the line. If they were of equal strength, then the magnetic effect in each would be killed. But in this case they are not, for some of the neutralization current must cross from one side to the other, and this causes an excess of current in one side of the receiver, hence the sound.

Two principal troubles manifest themselves, and both are cases of unbalance. An open line is a case of unbalance, and so also is a grounded line. The metallic circuit, when paralleled by the trolley, may be said to be at five hundred volts of electrostatic potential. One can easily imagine that a line which has broken glass or rests upon guy wires is likely to become noisy. When the metallic line becomes grounded on one side the line roars like a waterfall. It will roar the same way when open on one side. The effects are the same, because both are cases of unbalance. We have seen before that a difference of five ohms would make a metallic line noisy, and an open circuit is only one with high resistance on the affected side. It is infinite resistance, of course; but it acts like any finite resistance. The effect of 1,000 ohms on one side of a line with 150 ohms on the other will give equal results. This will cause one-half of the winding of the bridged receiver to carry more than its share of the neutralization current, and noise will result. A ground on one side of the line also causes the receiver halves to be unequally loaded, and one hears the fluctuations of the street railway currents; he can hear the cars starting and stopping; the hum of the station, and everything else that has varying potentials or currents in their circuits.

After the cars cease to run the grounding of a line is not such a serious matter. In places where there are no electrical disturbances the grounding of a metallic line will cause no particular trouble. But if these same wires are paralleled by a trolley line new conditions arise. A ground on one side before did not cause any noise because there was no static

current to take off; but when parallel with the trolley the line may be imagined to be covered with static charges from the earth at a potential of 500 volts or more. If a ground is placed on the line at the middle points of a bridged receiver no noise will be heard, but the charge will escape just the same. With the ground on one side, the charge escapes also, but the receiver will not be neutralized and the noise is heard. A car is started; the trolley carries more current; the trolley pressure is reduced slightly and an electrical change takes place. The charges on the line change as the inducing currents change, hence one hears the cars start.

The most peculiar effect of a line open, or grounded, on a trunk lead of twenty-five pairs is the effect upon the other twenty-four lines. We will suppose that all the lines are reasonably well transposed and balanced. Now suppose that one line gets out of order, either grounded or open. Then all the other lines are affected in a curious manner. Each line brings out its defects of balance. If there is but a fractional unbalance it becomes noisy just that amount, due to its departure from exact balance. Some of the lines are actually noisy, and others only show faintly that unbalance exists. The inspector should discover which are the best balanced lines, and remove the defect of this particular line. This done, all other lines will become normal and will work as quietly as their natural conditions permit.

This occurs when cars are running and when a potential of 500 volts are in close proximity to the trunk lead. Let the system be shut down, and the disorderly line will not cause so much noise from the ground, nor will the companion lines be affected in the least. If the trolley current is turned on the different lines at once assume the noise that is due to their imperfections as regards balance and insulation.

The sensitiveness of the trunk line of considerable length, paralleled by the trolley, is so great that a common battery cord circuit has to be well balanced to connect the ordinary subscriber with the trunk. In one system the cord relay of low resistance is sufficient to put the line considerably out of balance. This same system fails utterly when connecting a grounded line to a metallic trunk circuit. Repeating coils are manufactured to overcome some of this difficulty; but grounded lines are used only in large cities and are devices for overcoming the shortcomings of franchise conditions.

The transpositions on a lead of twenty-five circuits must not be made at random, but should be laid out with mathematical exactness. Transpositions put in wherever the lineman sees fit will not prevent cross-talk nor inductive disturbances.

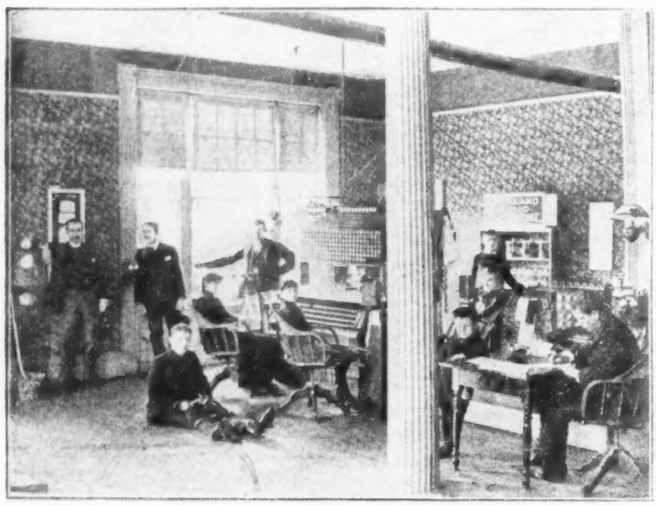
Cutting in one transposition, on some trunk lines, will totally destroy the proper operation of circuits. They depend upon polarity of current, and when any work is being performed on a trunk line it should first be put out of commission at the central office.

A PIONEER EXCHANGE.

INDEPENDENT TELEPHONY IN THE EIGHTIES.

The following history of the first Independent telephone exchange of any considerable size, from its inception to its unfortunate end, is interesting and instructive.

The Baxter Overland Telephone and Telegraph Company of Central New York was organized to operate under

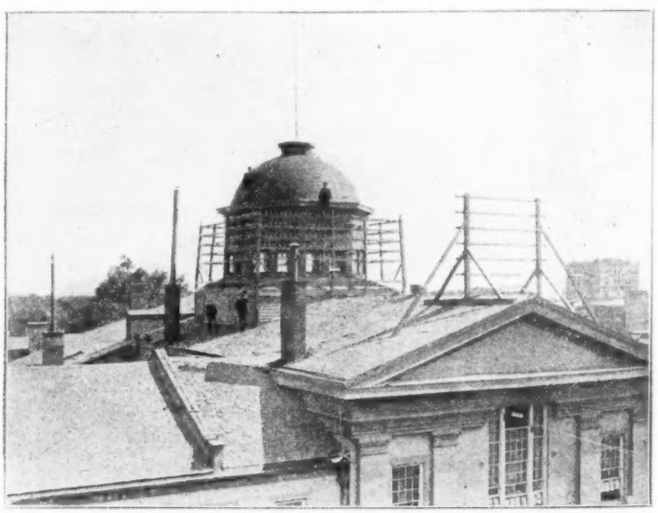


OFFICE AND SWITCHBOARD OF BAXTER EXCHANGE.

the patents of Dr. Myron L. Baxter of Washington, D. C. It purchased the exclusive right for the use of these patents in the counties of Oneida, Herkimer and Lewis, N. Y., for the sum of $15,000 cash, not stock. The promoters were George M. Lowery and A. W. Mills.

The company was chartered May 2, 1884, under the laws of the State of New York. It claimed a backing of $3,500,000, and guaranteed its subscribers against all claims for damages for the use of its instruments by reason of alleged infringement of telephone patents.

The instruments used were of the Baxter type, patented May 8, 1884. The transmitter, the generator, the ringer and the hook switch were mounted in one box. One of the advantages claimed for these instruments was that by opening the box, the back electrode of the transmitter could be manipulated as a telegraph key, and that in case the transmitter failed to work, the persons conversing could send or



TOWER AND TWELVE-HUNDRED-WIRE BRACKET.

receive a message by telegraph, provided, of course, they were telegraph operators.

The company went to work on a large scale, but difficulties were met with from the start.

It was intended to erect poles for the distance of half a mile on the main street of Utica, and opposition from the citizens was feared. In order to avoid trouble Mr. Chas. A. Rolfe, the manager of the new company took time by the forelock. Fifteen hundred poles had been shipped from Canada, and at midnight of Saturday, June 15, a large construction gang was put to work. While the people of Utica slept peacefully twenty holes were dug, twenty 70-foot poles were raised, and by 9 o'clock Sunday morning a single wire was strung for half a mile along the main street. It is said that the astonishment of the people when, on their way to church that Sunday morning, they found their streets literally torn to pieces, was beyond description.

After this the work went on merrily. The exchange was

TOWER AND POLES, FROM FRANKLIN SQUARE.

located in Mechanics' Hall building, at the corner of Hotel and Liberty streets. From this building radiated seven leads of poles, none shorter than 40 feet, on which were strung over 500 miles of No. 14 steel wire, terminating in a mammoth 1,200 wire bracket, surrounding the tower. From this bracket the wires were led into the 1,000 lightning arresters, arranged in a single row, and thence by cable to the switchboard on the second floor.

The switchboard was of peculiar construction, and was operated by four girls, two on each side. The board and apparatus and the entire working force are shown in one of the accompanying cuts.

The exchange went into operation at noon on October 15, 1884, with 300 subscribers actually connected, and line work completed for 800. The company's substantial backing, the energy and resource of its manager, and the splendid construction elicited the confidence and enthusiasm of the citizens. Its patronage increased rapidly. The rates were $30 and $24, less than half of those of the Bell. In five months the Bell subscribers dropped from 500 to 250. Elaborate plans were made for long-distance lines. The field was wide. There seemed no prospect of successful interruption, and during the winter of 1884 and 1885 Baxter interests boomed as steadily as Bell interests declined.

But the Bell octopus is many-eyed, and never sleeps. In its den at Boston its plans were matured, and before the spring opened it made an attack with such determined vigor that on March 17, 1885, the Baxter company was compelled to issue a circular notifying the subscribers of a temporary suspension of its business.

There is no doubt that the Baxter instrument was an infringement on the Bell fundamental patents, and in the face of this fact the new company's attempt to operate was foolhardy in the extreme. The courts decided against them, and operations were never resumed.

It is interesting to note the excellent ideas of construction incorporated at that early date into this exchange. Telephone managers of to-day would do well to follow the example set by these pioneers. The use of forty, fifty, sixty and seventy foot poles, with ten-inch tops, placed seven feet into the ground and forty to fifty per mile, meets all the requirements of the best modern practice. Out-of-town lines were of No. 14 hard-drawn copper wire, then a novelty, and great doubt was felt as to their satisfactory behavior. Several other features that have since become common practice were adopted in this exchange for the first time, in that section at least. All calls were made by number, the previous custom having been to call by name. Each subscriber was called up daily to ascertain if the lines and instruments were in proper working order. Everything was numbered—poles, instruments, circuits, etc. A rigid system of inspection and reports was inaugurated. All fire-alarm wires were arranged on the top pins of the poles, and were for the free use of the city.

Mr. Rolfe says the bane of his existence was keeping the night operator awake. There was no form of night alarm then in use, and he was compelled to devise one that operated in a manner most severe for himself as well as the operator. A segment was arranged to travel up a given path by means of a clock movement. It took the segment just fifteen minutes to cover this path, and when it reached the top a circuit was closed and a bell rung in the manager's house. The only way to prevent the bell from ringing was for the operator to pull this segment down just before it reached the top notch. This necessarily limited the operator's naps to fifteen minutes each, and frequently broke in upon the slumbers of the manager.

GENNESSEE STREET, LINE OF SEVENTY-FOOT POLES.

LOCATING MINERALS.

News from London has been received to the effect that a new system of locating mineral ore has been tried at the Teleace lead mines in north Wales. An alternating current of high potential is used to energize the ground thought to contain mineral deposits. The current is taken from terminals to two metal rods pushed an inch or two into the earth. These act as distributors of the electric force, which is detected by means of a delicate telephonic receiver attached to another pair of rods stuck in the earth at any required position.

The presence of ore is indicated by the greater or less intensity of the sound produced in the telephone.

The Telephone of Yesterday and To-Day.

It is a long way to harken back twenty-five years, to the early days of the telephone with all its crudities, to the days when its possibilities were undreamed of, when the instrument that has knit the commercial and social world so closely together was only a toy. A very wonderful toy, of course, but of little commercial use. In the present state of the telephonic art it is hard to believe that a short quarter of a century ago, our marvelous telephone was something little known and little used. All telephone men will read with interest the reproduction, on this and the following page, of the first issue of a telephone publication, and to those who have, comparatively speaking, grown old in the service the perusal of the first copy of the Telephone Journal will have an added interest. They have watched the industry grow from a few crude instruments installed here and there, to its present development. And its progress has been nothing short of marvelous. There are to-day, of both Independent and Bell, nearly ten thousand exchanges connecting some five million telephones and giving direct service to approximately fifteen million people. And the wonder of it is that the movement is in its infancy. We shall look back twenty-five years hence and our surprise will be even greater at the progress of the telephone's second quarter century.

To those of us who are familiar with the present system of the Chicago Telephone Company it seems strange to read of the following, taken from the Telephone Journal of October, 1878: "Meantime we would suggest to our subscribers that where short messages are to be sent, time can be saved by sending them to the central office for transmission, from whence they will be repeated to destination." We can imagine the impatient, rushed business man of to-day putting up with this class of service. We append a letter from Mr. Angus S. Hibbard, general manager of the Chicago Telephone Company, which touches on the art of telephony as practiced in 1878, with some interesting data concerning the art to-day as exemplified by a modern telephone exchange. The letter follows:

THE TELEPHONE JOURNAL

No. 1 CHICAGO, OCTOBER, 1878 Vol. 1

THE MICROPHONE.

Some Remarkable Experiments—An Improvement on Hughes' Invention.

Nature (London) publishes a remarkable paper by Mr. James Blyth on a new form of the Microphone, which requires neither battery nor telephone. As *Nature* remarks, the curious importance of Mr. Blyth's invention need not be insisted on. By backing-up the pictures in a drawing-room it might, as has been suggested by a learned professor, be converted into an Ear of Dionysius, and Horace's words, "suppositos cineri doloso," would come to have an awful meaning. Mr. Blyth says:

"The following experiments were suggested by the description, which appeared recently, of the Microphone lately invented by Prof. Hughes. Instead of the pointed piece of carbon supported between two pieces of the same material, as used by him; it occurred to me that ordinary gas cinders would be likely to answer the purpose tolerably well. To test the idea I put in the circuit of an ordinary Bell Telephone, a single Leclanche cell, and a small jelly can half filled with cinders, broken into pretty coarse fragments. The connections were made by slipping down at opposite sides, between the cinders and the sides of the jar, two strips of tin, to which the circuit wires were attached. When the simple instrument was used as a transmitter, articulate sounds were heard very loud and distinct in the distant Telephone, though occasionally marred by what appeared to be the rattling of the cinders in the jar. With this transmitter sounds were also quite audible, even when the speaker stood several yards away from it.

"I next took a shallow box, made of thin wood about fifteen inches by nine inches, and filled it with cinders, taking care in the first place, to nail to the inside of its ends two pieces of tin to which wires could be attached. Having nailed down the thin lid of the box, and included it in the circuit of the Telephone, along with one Leclanche cell, I found that it made both a very sensitive Microphone as well as an excellent transmitter for the ordinary Telephone. With three of these boxes hung up like pictures on the walls of a room, and connected in circuit, almost any kind of noise, made in any part of the room was revealed in the Telephone. Speaking was heard distinctly, and a part-song by two voices in the middle of the floor was rendered with surprising clearness and accuracy.

"In my next experiment still using the same cell in the circuit of the Telephone, I tried as transmitter a single elongated cinder with the wires wound tightly round each end. Sounds uttered close to this cinder were quite audible, but I failed to hear them when I substituted for the cinder the carbon of a Benson cell with brass clamps firmly attached to each end, into which the circuit wires were screwed. Possibly either the more porous and friable nature of the cinder or the comparative looseness of the wire attachments, may have had something to do with this difference of effect.

"I next removed the Leclanche cell from the circuit and used as transmitter the jelly can containing dry cinders. I sometimes fancied that I heard sounds even with the cinders dry, but they became faintly though distinctly audible when the cinders became slightly moistened by the breath of the speaker. However, on pouring water into the jar, so as almost to cover the cinders, the sound was heard on the Telephone almost as well as when the Leclanche cell was in circuit. I did not, however, hear any sound with the cinders removed and water only in the jar, not even when the conducting power of the water was increased by being slightly acidulated.

"In my next experiment I tried if the jar with the cinders would act as a receiver as well as a transmitter, and was not a little surprised to find that it did so. For this purpose I used similar jelly cans, containing cinders both for transmitter and receiver, and included a battery of two Grove's cells in the circuit. Articulate sounds uttered in the one cinder jar were distinctly heard in the other, and even voices could be distinguished. However, the results were not so good as I have no doubt they will yet be, when better forms both of transmitter and receiver are adopted. Here we have the beginning of a kind of Telephone which will [illegible] electric current without the aid of magnetism. Hitherto I tried successfully an ordinary Telephone as transmitter and a cinder jar as receiver, but in this case, the sounds were somewhat fainter and not so easily distinguished. I remarked, also, that when an intermittent current was sent through the cinder jar, a very distinct rattling noise issued from it.

"In order to find out if the cinders in the receiving jar were at all jostled about when sounds were being transmitted to it from a similar jar, the following experiment was tried: A strong battery was included in the circuit, and a clean glass jar containing cinders taken as receiving instrument. When this was taken into a dark room small flashes of electric light were observed, here and there among the cinders while sounds were being sent."

BELL TELEPHONE CO.

In view of the numerous demands made upon us for Telephonic connection, we have not been able, even with the enlarged facilities at our disposal, to place *all* our subscribers in as *instant* communication as we shall eventually. We have been compelled to place so many subscribers, in some instances, upon one wire, that a short delay will be experienced at times in making connection.

Since the first introduction of our system, but four months ago, the calls have increased from 5 per day to about 1,000 at present writing. Every effort, however, is being made to bring our facilities up to the daily demand.

Meantime, we would suggest to our subscribers that, where short messages are to be sent, time can be saved by sending them to the Central Office for transmission, from whence they will be repeated to destination.

Arrangements are now completed for the connection of all the Railroads with our central system; this and the establishment of three branch stations in different parts of the city, will give facilities of inter-communication never before attainable, and we expect to accomplish all this in the next 30 days, during which time the additional wires necessary to fully accomplish the aim of our enterprise will be run to those now using our instrument.

April 23, 1903.

Editor TELEPHONY, Chicago:

Dear Sir—It has been very interesting, indeed, to read the copy of the Telephone Journal published in Chicago under date of October, 1878, and to compare a few of the statistics of the present day with those published at that time.

The service to the public in general is best indicated perhaps by the number of calls. The Telephone Journal notes that the "city has increased in population to 500,000 and the telephone calls have reached a maximum of 1,000 per day." At the present time there are a number of single subscribers whose daily use of the telephone in the Chicago exchange exceeds 1,000 calls.

The central office described in the Journal serving the wires of all subscribers, the wires entering through a cupola

and radiating over the surrounding house tops, has expanded into a system of fourteen city exchanges, twelve being in buildings owned by the company and erected for its sole occupancy, serving a total of over 67,000 telephones, four of the offices serving over 7,000 telephones each.

More than 125,131 miles of wire are now contained in underground cables, many cables containing 800 wires, and the total wire mileage of the Chicago exchange aggregates 159,280 miles.

The patrons of the exchange, instead of being contained within a radius of not more than one mile, now have communication within an exchange area of about sixteen miles long by five miles wide. The telephone has become not only a desirable piece of furniture for the desk of every busy man, but has found its way into the places of business and the residences of thousands, who by paying five cents for a call at the time the service is rendered are put into communication with any telephone in the Chicago Exchange. Within the radius of the Chicago Telephone Company as established twenty-five years ago, *i. e.*, a district including the cities and towns within forty miles of Chicago, there are now established one hundred and nineteen exchanges, serving more than 20,000 telephones outside of the city and connected with the Chicago exchange by 807 toll lines comprising 11,750 miles. In addition the Chicago exchange, as well as all other exchanges in the company's territory, is directly connected with the system of the Long Distance company and thereby with more than 20,000 offices throughout the country east of the Rocky Mountains by means of which 1,277,983 telephone stations are reached.

Certainly these tremendous increases in public service and its present efficiency are tributes, not only to those who embarked in the new enterprise in 1878, but to the thousands of workers who since that time have been devoting their time and energies to its best development.

A. S. HIBBARD,
General Manager.

THE TELEPHONE JOURNAL.

THE TELEPHONE JOURNAL,
BELL TELEPHONE COMPANY
PROPRIETORS.
OFFICE, 125 LA SALLE STREET

CHICAGO, OCTOBER, 1878.

SALUTATORY.

The daily increase in the number of subscribers to our "Telephonic Exchange," and the success which has attended our efforts to place the business community in *rapid* and *reliable* communication with their various interests, has induced us to establish the TELEPHONE JOURNAL, which is designed in the interest of our patrons.

It will be issued monthly, or oftener as required, will contain from time to time such items of Telephonic and general information as will be interesting, and we trust will be found a valuable aid to those desirous of informing themselves on the subject of Telephonic communication.

It will be distributed gratuitously to our subscribers, as issued, and will be found on file at all the Hotels, Club Houses, and places of resort in the city and neighborhood.

Numbers of copies will also be sent to the agents of this Company in the different cities of the Union, for distribution.

It will be the aim of the *Journal* to make its information as reliable as the *Telephone* itself, and we shall endeavor to make it especially *Telephonic* in appearance, and variety of matter—we commend our enterprise to the investigation and consideration of all interested.

TELEPHONIC EXCHANGES.

The system of a "Telephonic Exchange," designed only by the Company, will be fully appreciated when its operation and convenience is fully understood by the public.

It is simply the *centre* from which all wires radiate, and being in the heart of the business section is readily accessible.

Every Telephone has direct connection with this Central Office, and each subscriber has the same facility of communication from this centre as he has from his own instrument.

As stated elsewhere, the object of the Central Office system is to, place any of the parties using a Telephone in direct communication, and for this purpose a large operating room is required.

Into this room, through a cupola, are introduced all the wires used in the system.

These wires are attached to a "switch board," and each has its particular "call," or letter, or number.

The possessor of a Telephone, for example, wishing to talk to another possessor of an instrument, simply turns the crank of his machine, and is immediately answered by one of the numerous attendants in the operating room, who, on ascertaining the name of the party desiring to be "talked to," places both in *direct* communication. The process occupies but a few seconds, and is interesting only to the looker on in the liveliness it inspires in the persons employed to "connect," especially when the "calls" are numerous.

THE BELL TELEPHONE AT THE PARIS EXPOSITION.

Contradictory reports having been circulated in regard to the matter, a recent cable dispatch from Prof. Bell announces that his instrument has received the highest award—viz: *the only Gold Medal offered.*

SUBMARINE TELEPHONING.

Editor Engineering News:

SIR:—I enclose you herewith a brief account of a recent use of the Telephone, which you may possibly think of sufficient interest to publish. I can vouch for the correctness of the account and for the perfect success attending the use of the Telephone as then stated having used it myself under water several hours almost daily for the first two weeks of last month. The examinations were of the under portion of the sea wall in Boston Harbor, and reports had to be made every few minutes of various short measurements, etc. I believe the Telephone will be universally used in submarine work, as with it can be avoided the loss of time and the fatigue incident upon frequently coming up to converse with or report to those above water.

I am very truly yours,

Grantville, Mass. FRANCIS D. FISHER, C. E.

The first use of the Telephone under water in this country has been recently made, in connection with Submarine Examinations in Boston Harbor. The character of these examinations was such that it would have been impracticable to undertake them without its aid as almost constant communication was necessary between the diver and his assistant in the boat. The Telephone used under water has a metalic case so modified in form as to occupy but little space, and is attached by screws to the inside of the diver's helmet in such a position that either the ear or the mouth can be applied to it. In the boat a single Telephone of the ordinary form is used. The insulated copper wire connecting the two Telephones passes through the air pump box. Between the pump and the diver's helmet it is wound spirally around the air hose, the wire and hose being then tightly wound around with canvas for protection from injury. At first two connecting wires were used, the second not necessarily insulated, but it has since been found better to substitute for the second wire, a shorter wire connecting the upper Telephone with a copper plate fastened under the boat.

The Telephone was used in the above case, with entire success, by Mr. John A. Webster, of Boston, a practical submarine diver, to whom is due, we believe, the credit of first employing it in submarine work.

The details of its application to this service were designed by Mr. Francis A. Wenton, Superintendent of the Bell Telephone Company.
Engineering News.

GROWTH AND DEVELOPMENT.

In another article in this issue a contributor has briefly sketched the rise and progress of telegraphy, until, in the invention and bringing into practical use of our system of *Telephony*, the acme of development, in that branch of science would seem to be attained.

Yet, in view of the progress made, not only in this but every branch of known science, it would hardly seem premature to attempt to forecast the future.

This remark is as applicable to events as to science.

The veil of the future will remain impenetrable, but the increase of facilities will, in like manner, enlarge the expectation.

The discovery of steam marked an era in the history of events, yet Fulton never dreamed of the importance his discovery would attain as a factor in the economy of to-day. Stephenson, in applying it to the uses of transportation, doubtless never presumed, in his most sanguine moments, to fore-estimate the number of miles of Railroad that *to-day* gridiron the earth.

From the tea-kettle to the locomotive—or, the first attempt at telegraphy to the *Telephone*—was but a step, and quite comprehensible to us who daily experience the necessity of both; yet, are we prepared to calmly contemplate the substitution of the balloon for the locomotive, or such a height of cultivation and power for the human voice as will enable us to discard the Telephone?

The principle of growth and development permeates everything. The population of the world increases, villages become towns, and towns become cities, and the latter expand even beyond the definition of the word "metropolis."

Our own City of Chicago affords the most notable example of this principle of growth and development. Fifty years ago a settlement—to-day a metropolis of over half a million! Yet its growth increases and its business constantly demands increased facilities.

It is the "Central System" of a gigantic and ever increasing trade, and its influence is felt wherever steam and telegraph wires penetrate.

It is not surprising, therefore, that the *Telephone* system, so lately planted in this city should at once partake of the local characteristic, and grow and expand until its wires penetrate in all directions.

The introduction of the *Telephone* as an aid to the *further* development of the native spirit and enterprise of the community is at once seen and appreciated, and its adoption, so speedily, is but another instance of the sagacity and intelligence characteristic of the locality

TELEPHONE SYSTEM FOR BROOKLYN ELEVATED.

An announcement was made last week by J. F. Calderwood, assistant to President E. W. Winter, that a complete telephone service is to be installed on all divisions of the Brooklyn Elevated road.

Mr. Calderwood said that the plans and specifications for the work are being drawn and that the system should be fully installed and ready for use within 60 days. It will be a private service, and all lines will connect with an exchange at the Bridge terminal. This exchange will be connected with the main office of the Brooklyn Rapid Transit Company on Montague street, and with the public wires, so that communication in case of emergency or trouble of any kind may at once be had with the officials of any department of the Brooklyn Rapid Transit system, or with police or fire headquarters.

The telephone service will answer a double purpose. It will be effective, it is believed, in preventing robberies, which have not been infrequent at some of the stations on the "L" system, and in putting a stop to much of the boisterous conduct and ruffianism of which there has been so much complaint during the early hours of the morning, particularly when the stations are practically deserted, as help may be summoned from the opposite side or from the nearest station in a comparatively few minutes, while at the same time communication may be opened with the police.

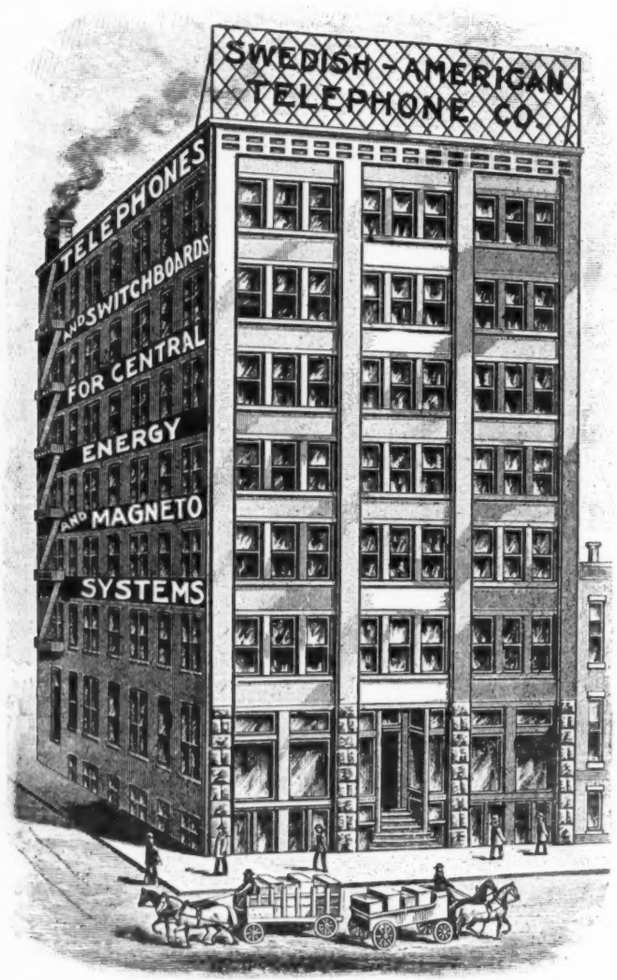
It is also intended to use the telephone in case of accident or delay on any part of the system, to advise passengers at the stations of such delay.

The telephone evidently fills a want in Germany. The number of conversations carried on with its aid in 1901 was over 757,000,000—or 2,086,171 a day.

MANUFACTURERS' SECTION

NEW HOME OF THE SWEDISH AMERICAN TELEPHONE COMPANY.

Readers of TELEPHONY are presented on this page with a view of the new home of the Swedish-American Telephone Company at 88-90-92 West Jackson boulevard, Chicago, Ill. The Swedish-American company has secured a ten years' lease on these premises, including the entire building of seven stories and a basement. The structure is well lighted and equipped with double elevator service, making it



especially well adapted for all requirements of the telephone manufacturing business. The machinery and apparatus is now being moved from the firm's former quarters, and everything will be ready for occupancy and operation at the new location by the first week of May.

Visitors to Chicago will find the new factory on the opposite side of Jackson street and but four doors west of the premises formerly occupied. The new building will afford more than twice as much room and will be equipped with all the most approved machinery, designed for the manufacture of modern telephone apparatus.

The department devoted to the manufacture of central energy equipment is to be especially enlarged and improved, in order to meet the growing requirements for this branch of the business. Other departments will also undergo enlargements to correspond with the firm's phenomenal growth.

When the Swedish-American Telephone Company started in business four years ago it took for its motto, "Nothing but the best," and has adhered to this principle consistently ever since. How well this platform has succeeded is best demonstrated by the firm's constant growth, which has necessitated its removal into the spacious new quarters. It has been its constant aim to permit nothing to leave its factory that has not first undergone a thorough test and has been proven thoroughly satisfactory and suitable for practical operation in every respect. These results have only been obtained by the exercise of correct business principles, applied to every branch and feature of the business, ranging from the selection of materials, through the process of construction and assembling, and on down to the actual installation. By such minute attention to details and the employment of able assistants in every department, the company has been able to carry out its original intentions and has established for itself an enviable reputation. There are few industries of the present age that require as scrupulous care and close attention as the telephone manufacturing business. Any inattention, however slight, too often results in defeated purposes, the consequence being dissatisfied customers and a decreased trade.

Another very gratifying and conspicuous feature of the growth that has marked the Swedish-American company's progress is the fact that it is always alert to every improvement that may possibly be made. Its transmitters have become popular because of their uniformly satisfactory and durable qualities. The company's new receiver, just brought out, is meeting all the requirements of up-to-date service.

The new desk set also is a decided innovation, introduced but a few weeks ago. This new piece of apparatus is distinguished by a self-contained hook and contact movement in which the entire construction can be removed as a unit without unsoldering or disturbing a single connection. It also enables repairs to be made, when necessary, in a very few moments and with perfect ease. The new apparatus is simple and practical, handsome in appearance and built in the most durable type.

The central energy apparatus of the firm possesses similar characteristics, and has met all expectations, wherever introduced.

It is such advanced ideas and such progressive operations as these, combined with wise business regulations and an ambition to succeed, that has enabled the company to achieve such a notable success in the Independent telephone field.

Readers of TELEPHONY, who have occasion to visit Chicago at any time, are cordially invited to call upon the Swedish-American in its new location, where they will find much of interest and where they will be accorded a hearty welcome, characteristic of the company and its heads of departments.

AUTOMATIC TELEPHONE EXCHANGES.

The Automatic Electric Company has begun the shipment of automatic telephone equipment to the Dayton Home Telephone Company of Dayton, Ohio, and the Citizens' Telephone Company of Grand Rapids, Mich. The Dayton

company will begin business with 6,000 stations, and its ultimate capacity will be 19,000. The Grand Rapids Company will have a present installation of 5,000, with an ultimate capacity of 19,000. Both of these companies have erected new buildings which are designed especially for the automatic exchange. An interesting feature of both of these large installations will be that no party lines will be used, each subscriber having a private wire. These, with the exchange of the Illinois Telephone and Telegraph Company in Chicago, will be the largest telephone exchanges in the world to give such service.

The Automatic Electric Company is also manufacturing complete equipment for the Citizens' Telephone Company of Columbus, Ohio, in which plant 7,000 stations will be installed at first with an ultimate capacity of 19,000. The Northeastern Telephone Company of Portland, Me., has also placed an order with the Automatic Electric Company for 2,500 telephones and switches, the switchboard to have a capacity of 10,000.

Out in Iowa the service which has been given for seven years by the automatic system in the city of Manchester, is having a wide influence. The recently organized Commonwealth Telephone Company has placed an order with the Automatic Electric Company for the equipment of 1,200 stations with a capacity of 10,000. An order has also been given by the Wettstein Construction Company, which will build the new exchange in Burlington, Iowa. This order calls for the present equipment of 800 stations and an ultimate capacity of 10,000.

A NEW PAY STATION.

The Chicago Pay Station Company has produced a new type of pay station which they have called the "1903 Model" and which presents some novel features as the result of that company's experience in the pay station field. The separate plunger feature has been replaced by a single pull lever, thus reducing the number of loose parts and giving less chance for trouble. At the same time the number of springs within the machine has been greatly reduced with a view to making it more reliable in action and cheaper in maintenance cost.

An air valve has been introduced to retard the return of the lever and to make the machine noiseless in operation except for the sound of the signals. A light mechanical flipper closes all of the slots as soon as one coin is deposited and does not re-open the slots until the first coin is deposited, and thus prevent the mistake of ringing up two coins at once. The rejector pocket provides, as usual, for the return of coins dropped in the wrong slot and for the return of small slugs.

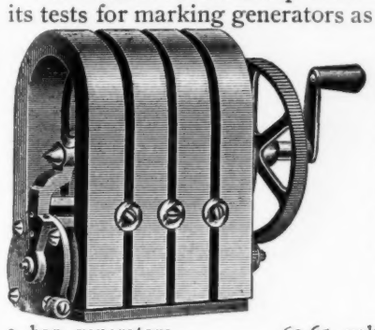
Another novel feature is the use of a system of electrical contact springs inside the box, which closes an electric circuit to ring an alarm at any point wanted in case the machine is tampered with. This makes the machine thoroughly sneak-thief proof. The feature is added only when purchasers desire it.

As heretofore with Chicago pay stations the entire coin collecting features of the device are kept purely mechanical without any electrical contacts whatever, and the parts are so constructed that maintenance cost will be the minimum.

The company will move May first to its new offices, 24 Kingsbury street, Chicago.

SYSTEM OF TESTING GENERATORS.

The Fisk-Newhall Telephone Manufacturing Company, in its tests for marking generators as to output of amperage and voltage, adopts as a basis a speed of two hundred revolutions per minute. This is about the speed the average man turns in making a call. As a result of the tests referred to we give below a table of the output of the various instruments manufactured by this company:

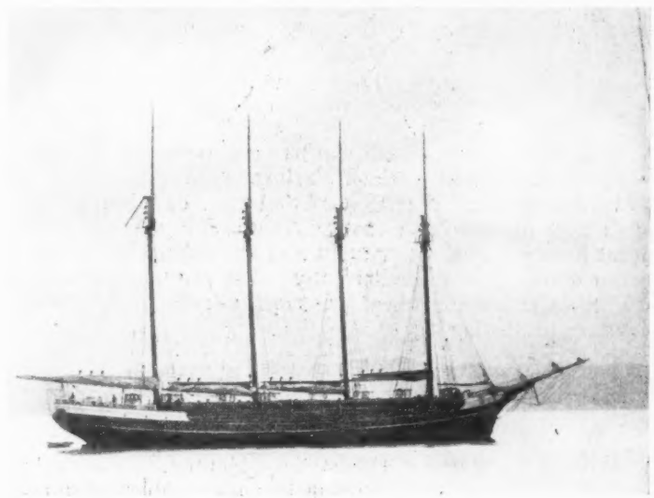


3 bar generators	62-65 volts	130 milliamperes
4 bar generators	65-70 volts	180 milliamperes
5 bar generators	75-80 volts	200 milliamperes

Every telephone sent out by the Fisk-Newhall Telephone Company is tested for the capacity of its generator, and the result is marked on a card attached to the telephone, signed by the foreman who has made the test, and a record kept thereof.

POLES ARE TRANSPORTED BY SEA.

The Lindsley Brothers Company, Chicago, have been enjoying such a heavy demand for poles from California and Southwestern points that they have found it necessary to ship by vessel from their Portland yards to the Los Angeles (Cal.) district. The accompanying cut represents the "Queen of the Coast" loaded with 3,200 poles, thirty-five feet and longer, which recently sailed from Portland, Ore., down

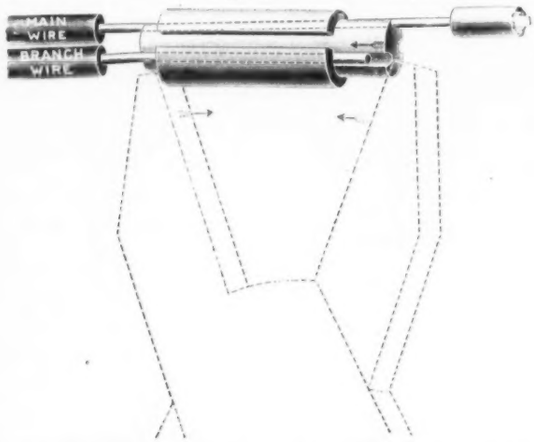


the Columbia river to the Pacific ocean, destined to Coronada Beach, Cal., where the cargo was transferred to cars and distributed to various points in southern California. This is one of the first shipments of the kind made, but as it proved a good means of avoiding the vexing problem of car service and supply, it will be followed by others in the near future.

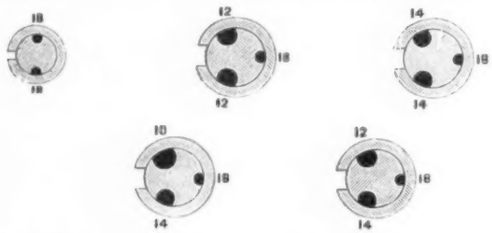
A NEW TEST CONNECTOR.

The Metropolitan test connector, made by the Yonkers Specialty Company, Yonkers, N. Y., is a new device designed particularly for party-line service. It consists of a tapered brass sleeve, into which fits a tapered plug with grooves designed to fit the various sizes of line wires used in telephone work. The connector is applied, as shown in the diagram, by the use of ordinary linemen's pliers, and may

be readily disconnected for test at any time. The small end of the plug is enlarged so as to prevent its becoming detached from the shell and lost. Three wire grooves are provided in each plug, two line-wire grooves and one groove for bridle wire. These grooves are designed so that the



circumference of the wires projects slightly beyond the circumference of the plug, consequently the wires bind against the outer tube as the plug is forced home. This tube being split, it is highly resilient, and therefore holds the wires with a strong spring grip, which insures a firm and permanent electrical connection. The device is shown full size in the

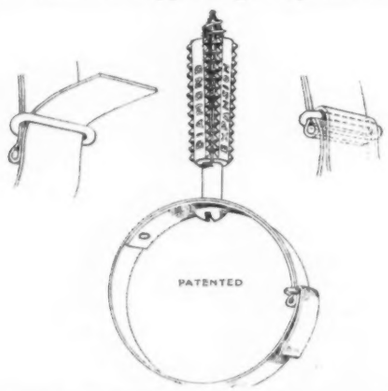


cut. It will be seen that it can be readily tapped if desired

There have been various devices upon the market for party-line service. It is claimed that most of the mechanical appliances for making a connection which can be opened for a test have been cumbersome in size and otherwise defective, both electrically and mechanically. The connector above described is claimed to meet the requirements of this service in every particular.

ADJUSTABLE CABLE HANGER.

The illustration below shows the "Diamond adjustable cable hanger" used for supporting telephone cables or pipes



DIAMOND ADJUSTABLE CABLE HANGER.

from ceilings or sides of walls. This hanger consists of a strap of zinc, with a simple locking device arranged so that the metal is doubled at the top to do away with the possibility of the bolt pulling out.

The cable can be easily suspended and its weight tightens the hold of the lock. The standard clamp is ten and one-half inches long and will fit all sizes of cable up to 200 pair. It has been adopted by the New York Telephone Company and other leading companies, and is sold in connection with the Diamond expansion bolt by the New Jersey Foundry and Machine Company, 9 to 15 Murray street, New York.

"TO THE PRESIDENT."

The following is a fac-simile of a letter received at the office of the Stromberg-Carlson Telephone Manufacturing Company in acknowledgment of receipt of a gold paper weight, which was a reduced model of the Stromberg-Carlson receiver, mounted on a base. A small silver plate bearing the words "To the President" fastened to the base completed the attractive and appropriate souvenir, which was presented to the president April 2, on the occasion of his visit to Chicago.

Personal.

WHITE HOUSE.
WASHINGTON.

Sioux Falls, S.D.,
April 6, 1903.

Gentlemen:

Your recent favor has been received and I beg to thank you in the President's behalf for the thoughtful courtesy which you have been good enough to extend to him.

Very truly yours,

Wm Loeb, Jr.

Secretary to the President.

Stromberg-Carlson Telephone Mfg. Co.,
Chicago, Ill.

RURAL MAIL DELIVERY BY TELEPHONE.

The transmitting by telephone of important letters to people residing in rural districts is now being strongly agitated. The plan as now outlined is to add to the free delivery methods, the authorized opening of letters by postmasters, and telephoning their contents to the recipient. The idea is that a special stamp be issued, which shall denote to the receiving postmaster that the envelope is to be opened and the contents telephoned to the person addressed. Such a course would, in case of important letters, save valuable time. The postal authorities and the various telephone companies would necessarily have to make some mutual agreement as to the handling of this class of matter. Already an attempt has been made in the present congress to insert an amendment in the postal appropriation bill to that end, but it has failed; still it is a foreseen conclusion that somewhere in the future rural delivery by telephone, when requested, will be in practice.

TRADE NOTES

THE STANDARD TELEPHONE AND ELECTRIC COMPANY, Madison, Wis., has issued a new catalogue showing its line of high-grade apparatus, including a number of new and clever ideas.

THE CREAGHEAD ENGINEERING COMPANY, Cincinnati, Ohio, has spared no expense in the preparation of its new catalogue. It contains quite a number of suggestions pertinent to telephone construction.

THE STANDARD VITRIFIED CONDUIT COMPANY, 39 and 41 Cortlandt street, New York, is issuing a handsome brochure. It is a unique design and is devoted to the Standard company's conduit and clay products.

THE WARNER ELECTRIC COMPANY, Muncie, Ind., is now arranging its pole changers for both electric signaling and alternating ringing. Although this is done on all orders and adds much to the value of the power generator, no extra charge is made.

THE FALLER AUTOMATIC TELEPHONE EXCHANGE COMPANY, New York, has leased a commodious new factory building at 772-774-776 Twelfth avenue. The new structure has six floors, with excellent light, and will accommodate 1,000 workmen.

THE VARLEY DUPLEX MAGNET COMPANY of Phillipsdale, R. I., is putting out a new catalogue of its offerings of electro-magnets for continuous and alternating currents. All sorts of coil windings form another feature of the company's regular output.

THE F. BISSEL COMPANY, Toledo, Ohio, has placed upon the market a special loud-ringing extension gong for use in shops, factories or buildings where a loud-ringing bell is necessary. This company is sending out descriptive literature and prices of these gongs.

THE W. J. NAGEL ELECTRIC COMPANY, Toledo, Ohio, is making a specialty of Becker protectors in combination with the Gilgen fuse, which are said to cover all requirements of the telephone business and to reduce expenses to a minimum by rendering carbon unnecessary.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, has been awarded the contract for the switchboards of the Tri-State Telephone Company at Uniontown and Connellsville, Pa. The contract calls for two central energy boards, with a capacity of 1,800 subscribers each.

THE F. BISSELL COMPANY, 228 Huron street, Toledo, Ohio, issues a series of catalogues that contain valuable information. Description of its devices for electric lighting, power and railway construction, switchboard apparatus and specialties for telephone construction form the subject matter.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, manufacturer of ignition batteries and spark coils, has issued its catalogue of supplies, consisting of a description of autocells, tubular autocells, multiplex batteries, Columbia dry cells, Rex closed-circuit cell, National No. 2 carbon porous cup cell, type D four-battery and National metal case waterproof spark coil. The company asks all who have not given their goods a trial to do so, and assures that at all times careful and conscientious methods of doing business will be pursued.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is experiencing a rapid expansion of its rubber-covered wire business and has been compelled to enlarge its warehouse room very materially. Additions have been made to the working force and the company is not allowing itself to get behind with orders.

THE COMMERCIAL ELECTRIC SUPPLY COMPANY, St. Louis, Mo., has lately enlarged its facilities for handling its increasing business. It is finding the leverage of a central location to be very important. "O. K." waterproof and slow-burning wire are among the supplies for which this company holds the agency.

THE FOWLER-JACOBS COMPANY, Chicago, shippers of cedar poles, presents a tastefully conceived blotter showing photographic views of one of its many lumber camps in northern Wisconsin. This company has yards in Idaho and in Washburn, Brule, Plummer, Upson, Hopkins, Van Buskirk and Milwaukee, Wis.

THE ELECTRICAL SUPPLY COMPANY, Madison, Wis., is putting out an illustrated folder descriptive of a number of patented specialties that should prove of interest to telephone buyers. This is one of the younger firms in the electrical field, but it is rapidly making itself known and appreciated over an extensive territory.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD CO., Providence, R. I., announce that its new catalogue is ready for those who write for it. Not having a copy at hand, we are unable to state its particular difference from other catalogues of similar kind, but it may be safely assumed that much new and important apparatus is described.

THE CAROLINA LOCUST PIN AND MICA COMPANY, Franklin, N. C., has increased its capacity recently and is in better position than ever to take care of business promptly. The pins made by this company are of the best variety of locust and are made exactly according to specifications. This company carries large stocks ready for shipment.

THE SWEDISH-AMERICAN TELEPHONE COMPANY, Chicago, has just issued a catalogue that is entitled to be called artistic. Printed on heavy enameled paper, with handsome cover and excellent illustrations, it is worth preserving, and on account of its subject matter will interest every up-to-date telephone man. The catalogue may be had on request.

THE INSTITUTE OF ENGINEERS OF THE RIVER PLATTE, whose secretary is Ernest Danvers, Calle 475 B. Mitre, Buenos Ayres, announces it will be glad to receive catalogues from United States manufacturers for placing in the library of that institution. No doubt every manufacturer who may read this notice will be glad to respond with a view to future business.

THE EUREKA ELECTRIC COMPANY of Chicago has issued an artistic booklet entitled "They Say." The "sayings" come from pleased patrons and testify to the quality of the apparatus put out by the Eureka company. Several of the testimonials reveal the fact that this company has recently filled a number of large contracts for South American governments.

THE WESTERN ELECTRICAL SUPPLY COMPANY of St. Louis, Mo., is issuing its general supply catalogue No. 50. The company is to be congratulated on the appearance of

this magnificent work, which is one of the most complete listings of specialties, tools, construction materials and general supplies ever issued. The catalogue is sent upon application.

THE MODERN ELECTRIC COMPANY, Burlington, Iowa, manufacturers of the celebrated Burlington telephones, is making special efforts in the introduction of its new bridging generators, which are said to be of extraordinary strength and efficiency. The company reports an unexpectedly large demand for its bridging telephones of the latest types, which are made under patents of its own.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, 358 Dearborn street, Chicago, makes a specialty of anything having a low fusing point, such as instrument fuses and fuse wire and strip for telephone fuses. The wires are of remarkable tensile strength, considering their fineness, and may be handled without difficulty. Shipments are promptly made from New York, Buffalo or Chicago.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports that so far this spring it has received more orders for Stombaugh guy anchors than ever before. It attributes this to the fact that the Stombaugh is easy to install and that its makers claim that it will stand a greater strain and will give more satisfaction in general than other anchors. The company will send a descriptive pamphlet upon application.

THE SPRAGUE ELECTRIC COMPANY, New York city, has issued its new catalogue No. 410, which illustrates and describes iron armored, brass armored, unarmored and flexible metallic interior conduit. A complete description is also given of its line of armored cables, conduit fittings, boxes, elbows and couplings, special tools and supplies of all kinds. All in all, it is a catalogue that is a creditable showing for the company issuing it.

THE HUBBS-NEER ELECTRICAL MANUFACTURING COMPANY, Eutler, Ohio, report great success with their Twentieth Century Dry Battery. It seems that this dry cell is especially adapted to severe telephone service, where the requirements are more than ordinarily difficult. This company has also been having a large sale for its Electric Soldering Paste, one shipment recently going to Cuyas, Aguiary & Co. of Madrid, Spain.

ROTH BROS. & COMPANY, Chicago, will remove May 1 to their new location at 27 and 29 South Clinton street, where they will occupy the entire building. This will give double the floor space now available, and in consequence greatly increased facilities for turning out orders promptly. This company bases its high reputation largely upon the excellence of its motors and dynamos, especially appealing to the telephone trade through its line of ringing generators, which seem to be meeting with favor.

THE NATIONAL ELECTRIC SUPPLY COMPANY, Washington, D. C., is now manufacturing and placing in the hands of the trade several new style switchboards. Among them are the style C party line switchboard and the combination party line and express switchboard. This company manufactures a style E "cut-in" instrument, by which if one end of a party line is in use, the end of the line not in use may be used by using the "cut-in." The instrument may also be used to advantage in exchanges under certain conditions.

THE HIPWELL MANUFACTURING COMPANY, Allegheny, Pa., has issued to the trade a unique and striking folder advertising its product. The folder is entitled "A Box of Good Ones." The company in describing its apparatus says it has the best telephone in the world, and backs up its assertion by saying that in its construction it is built of the finest material, and its sound transmission is based upon the best scientific application of principles. Special stress is placed upon the new Hipwell transmitter and its new metal-lined receiver.

THE WILLIAM MUELLER COMPANY, Chicago, dealers in posts and poles, has purchased the entire stock of the Holcomb-Lobb Company, who are retiring from business, together with their yards at Marinette, Wis., and Masonville, Mich. The Mueller company has greatly strengthened its position in the pole business by this stroke of enterprise—a quality for which it is noted. It is now able to promise greater promptness in shipments than ever and announces that the new arrangement will have a favorable effect on prices from the viewpoint of the consumer.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, Meriden, Conn., has sent out its new catalogue No. 7, which contains quite a number of late improvements and new styles. Among these are a new solid-back transmitter, which is equipped with a new resonating chamber, and a new self-contained receiver. The company has put in a new plant and increased its capacity to meet the demands of its rapidly expanding business. Its equipment for manufacturing all kinds of electrical supplies is now unexcelled anywhere in the East. While this company was only recently incorporated, it has been in existence since 1895.

THE MONARCH TELEPHONF MANUFACTURING COMPANY, Chicago, has removed from its old location at Canal and Randolph streets and is now occupying its new and much larger factory at 12 and 14 South Clinton street. This company attributes its phenomenal growth entirely to the quality of the apparatus manufactured and to the business principles followed. The present floor space is fourteen times as great as that occupied at the time the company started in business, not quite two years ago. Beginning with the manufacture of the well-known Monarch ringer, it has steadily expanded until it is now making a complete line of parts and telephones. With the increased facilities just secured it expects to continue making prompt deliveries, although the business is growing rapidly.

ARTHUR W. HOGE, formerly general superintendent and purchasing agent of the People's Telephone Company of Detroit, and Gustav Hirsch, chief engineer of the same company, have organized a construction company known as the Ideal Construction Company, and have fitted up temporary offices in room 14, Harper Block, Lima, Ohio. They recently closed a contract with the Lima Telephone and Telegraph Company for $40,000 worth of new work and have two other good contracts in plain sight. They are both experienced telephone engineers and have engineered some of the very best Independent systems in the country. They laid out and built the exchange at Columbus, Ohio, and some twenty different exchanges in Franklin, Knox, Licking and Fairfield counties. During the past year they have put in new exchanges at Lorain, Ohio; Jackson, Mich., and Springfield, Mo. They are both practical as well as theoretical engineers and are thoroughly posted on all the latest and best methods known in the telephone art. Any one contemplating new work of any description would do well to write them. Their references are the very best and we can recommend them most highly.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY of Rochester, N. Y., and Chicago, Ill., reports that it has begun the erection of a second factory in Rochester, which will engage in the manufacture of telephones. The plans call for a factory having two hundred thousand feet of floor space and to be capable of turning out two thousand

telephones per day. The company also reports having just secured the contract from the Home Telephone Company, Kansas City, Mo., for six thousand five hundred central energy telephones, and that it has recently sold switchboards and complete exchange equipments at the following points: Troy, Orrick and Gillman City, Mo.; Local Telephone Company, Crestline, Ohio; Harrisonville Telephone Company, Harrisonville, Ohio; Foster & Faber, Summerfield, Ohio; Rossville Home Telephone Company, Rossville, Ind; West Virginia Western Telephone Company, Parkersburg, W. Va.; Winchester Telephone Company, Winchester, Ind.; S. S. Hooks, Gilmore, Ill.; J. W. Gorin, Dahlgren, Ill.; Newport Telephone Company, Newport, Tenn; E. P. Phillips, Lakenan, Mo.; Zenith City Telephone Company, Duluth, Minn.; O. I. Miller, Woodburn, Ore.; Farmers' Telephone Company, Windsor, Ill.; Green Valley Telephone Company, Green Valley, Ill., and the London Mills Telephone Company, London Mills, Ill.

PERSONAL

B. N. Grenard is the new manager of the Independent telephone exchange at Fowler, Ind.

H. W. Simmons of Hurley, S. D., will be manager of the new telephone system at Hudson, S. D.

H. J. Peele of Wisconsin is the new manager of the Home Telephone Company of Springfield, Mo.

Dr. Henry E. Herr of Ottumwa, Iowa, has been in Chicago recently in the interests of the telephone business.

A. B. Hoff, promoter and manager of the Castleton (Ill.) Telephone Co., has purchased residence property at that place.

J. H. Parish, secretary and manager of the Standard Telephone and Electric Company, Madison, Wis., visited Chicago recently.

Irving W. Pope of New York is the new manager of the Findlay (Ohio) Telephone Company, succeeding C. O. Duval, resigned.

J. L. V. Turner, general manager of the Cuyahoga Telephone Company of Cleveland, Ohio, was a business visitor in Chicago recently.

Henry Bartlett of Eagle Point, Wis., has been appointed manager of the Chippewa County Telephone Company, vice Louis Fletcher, resigned.

G. A. Briggs, president of the Chicago Telephone Supply Company, Elkhart, Ind., was in Chicago a few days recently in the interests of business.

W. E. Doolittle of the Sterling Electric Company, Lafayette, Ind., was in Chicago during the early part of the month relative to business interests.

George A. McKinlock, president of the Central Electric Company, Chicago, and family have returned from a month's cruise and visit to the West Indies and the Bermudas.

Frank V. Newman of Detroit has been appointed assistant general manager of the Citizens' Telephone Company of Grand Rapids and will enter upon his new duties immediately.

The Pacific Commercial Cable Company will have an important station on Midway Island, in the Pacific ocean. Dr. Martin Crook, brother of Mr. J. F. Crook of the Automatic Electric Company, Chicago, has been tendered the position of medical officer to the large corps of operators and assistants.

J. E. Keelyn, superintendent sales department Western Telephone Manufacturing Company, Chicago and Winthrop Harbor, was at West Baden, Ind., for ten days the beginning of April.

A. J. Vernier, manager, and L. D. Gotshall, vice-president of the Independent Construction Company, Archbold, Ohio, were Chicago visitors recently. It is reported that this company will shortly remove to Kankakee, Ill.

Edwin C. Wetzel, lately district manager of the Federal Telephone Company, Washington, Pa., resigned the first of the month and has taken a similar position with the Home Telephone Company at Los Angeles, Cal.

President Bissel of the F. Bissel Company, Toledo, Ohio, has but recently returned from a trip in the interests of his company. His trip occupied about five weeks' duration and extended over a wide range of territory.

W. H. James, manager of the Wood County Telephone Company at Bowling Green, Ohio, has resigned his position and will go to Portland, Maine, where he will assume the management of the construction of an automatic telephone system, which is being installed in that city.

John Davidson, who for some time has been connected with the Germania Electrical Lamp Company of New Jersey, is now associated with the Sterling Electrical Manufacturing Company of Warren, Ohio. Mr. Davidson will make his headquarters at the New York office of the company, 26 Cortlandt street.

Thomas Bromley, Jr., general manager of the Delaware and Madison County Telephone Company, Muncie, Ind., advises that the plants at Elwood and Alexandria, Ind., are about completed and that when they are installed will give Delaware and Madison counties complete telephone service. He also states that this company is displacing the Bell at the rate of from five to twenty-five telephones per day.

Chief Goldsborough of the department of electricity at the world's fair, St. Louis, has just completed an extensive tour of the larger Eastern cities, such as New York, Philadelphia and Baltimore, in the interests of his department. He reports that practically all the large electrical companies of this country and a number in Europe will exhibit. He says that the applications from the United States are more than sufficient to fill the electricity building and that accommodations must be made for the foreign exhibits. The exhibit will include about everything of special interest pertaining to the field of electricity.

TELEPHONY is improving all the time.—F. E. MUDGE, La Salle, Ill.

"Sound Waves," a Chicago telephone journal, has been sold to Messrs. Wilson, Humphreys & Co. of Logansport, Ind. The new proprietors will continue publication at Chicago.

Taking the United States as a whole, the census shows that one person in every forty has a telephone. San Francisco leads the world in the generality of telephone use; there one in twelve has a telephone.

The Chicago branch of the American Institute of Electrical Engineers will devote its meeting of May 19 to a special telephone program under the direction of Messrs. Kempster B. Miller and Angus S. Hibbard. Discussions and papers by local experts will be presented. This is one of a series of meetings being held in the Monadnock building at the rooms of the Western Society of Engineers.

Incorporations of The Month.

Chiapas Construction Company, Dover, Del. Capital, $100,000.

Henrietta Telephone Company, Henrietta, Mich. Capital stock, $5,000.

Bedford-Fulton Telephone Company, Everett, Pa. Capital stock, $5,000.

Hillsdale Telephone Company, Pittsfield, Mich. Capital stock, $15,000.

Co-operative Telephone Company, Camden, Mich. Capital stock, $10,000.

Hurley Telephone Company, Hurley, S. D. Capital stock, $20,000.

Eden Valley Telephone Company, St. Paul, Minn. Capital stock, $10,000.

Commonwealth Telephone Company, Waterloo, Ia. Capital stock, $900,000.

American Telephone Company, Wilmington, Del. Capital stock, $400,000.

Osborne-Cheyenne Telephone Company, Osborne, Kansas. Capital, $4,000.

Monroe Mutual Telephone Company, Union, W. Va. Capital stock, $8,000.

Radcliffe Mutual Telephone Company, Radcliffe, Ia. Capital stock, $1,000.

North Branch Telephone Company, North Branch, Ia. Capital stock, $5,000.

M. H. Patterson Telephone Company, McCrory, Ark. Capital stock, $20,000.

St. Joseph Union Telephone Company, St. Joseph, Ind. Capital stock, $10,000.

Bracken County Telephone Company, Frankfort, Ky. Capital stock, $10,000.

Plankinton Telephone Company, Plankinton, S. D. Capital stock, $25,000.

Monroe County Telephone Company, Monroe, Mich. Capital stock, $15,000.

Henrietta Farmers Telephone Company, Henrietta, Mich. Capital stock, $5,000.

Mount Vernon Telephone Company, Washington, D. C. Capital stock, $5,000.

Capac Telephone and Messenger Company, Capac, Mich. Capital stock, $15,000.

Battle Creek Farmers' Telephone Company, Madison, S. D. Capital stock, $3,000.

Crab Orchard Home Telephone Company, Crab Orchard, Neb. Capital stock, $10,000.

Ochey Edan Automatic Telephone Company, Des Moines, Iowa. Capital stock, $6,000.

Anderson and Fall Creek Telephone Company, Pendleton, Ind. Capital stock, $40,000.

Atlanta Telephone and Telegraph Company, Wilmington, Ga. Capital stock, $400,000.

Stouts Creek Telephone Company, Stouts Creek, Monroe Co., Ind. Capital stock, $700.

Wakita County Telephone Company, Wakita, Okla. Officers not given. Capital stock, $100,000.

Hendrum Telephone Company, Hendrum, N. D. President, V. H. Moffatt. Capital stock, $5,000.

Farmers' Telephone Company, Egan, S. D. Capital, $10,000. Chief incorporator, N. H. Maupin.

Farmers' Mutual Telephone Company, Quimby, Ia. President, M. F. Hoffman. Capital stock, $10,000.

Evansville Telephone Company, Evansville, Ind. Incorporators: James Gray and others. Capital stock, $390,000.

Montana Telephone Company, Choteau, Montana. Incorporators: C. M. Drake, J. C. McQuaig, C. R. Scoffin.

Beaufort Telephone Company, Beaufort, N. C. Incorporators: N. W. Taylor and others. Capital stock, $2,000.

Burlington, Rochester and Kansasville Telephone Company, Rochester, Wis. Capitalization or incorporators not given.

Roann Telephone Company, Roann, Ind. Directors: C. T. Grimes, E. Connor, F. K. Barber. Capital stock, $15,000.

Laudersville Rural Telephone Company, Laudersville, Indiana. Capital, $4,200. Incorporators: Henry Wine, and others.

Brooklyn and South Norvell Telephone Company, Norvell, Mich. Directors: Daniel S. Fuller, N. J. Osborn, J. N. Harning.

Union Telephone Company, Marion, Ill. Incorporators: J. B. Bundy, J. C. Mitchell, A. F. White. Capital stock, $15,000.

Holt Electric Company, Carthage, Mo. Incorporators: Robt. Holt, J. F. Long, Paul W. Brogges. Capital stock, $10,000.

Vermillion Valley Telephone Company, Onaga, Kan. Chas. Day, president; Geo. Malone, secretary; Chas. Guffy, treasurer.

Strawn Telephone Company, Strawn, Ill. Incorporators: Eris C. Gullberg, Joseph Kuntz, J. W. Kirkham. Capital stock, $1,500.

Marion Telephone Company, Sterling, Ill. Officers: M. R. Peterson, president; J. W. Swedlund, secretary; P. Simpson, treasurer.

Co-operative Telephone Company, Rockfield, Ind. Directors: F. M. Tyrrell, C. L. Million, S. M. Clawsa. Capital stock, $3,000.

New Richmond Co-operative Telephone Company, New Richmond, Ind. Directors: M. L. Claypool, O. W. Mason, T. B. Miller.

Pottawattamie Mutual Telephone Company, Council Bluffs, Ia. Incorporators: F. R. Davis, Cal. Hooper, Charles Beno and others.

Alsea Telephone Company, Alsea, Oregon. Incorporators: W. H. Malone, G. C. Peck, D. D. Longhbottom. Capital stock, $1,000.

West Wisconsin Telephone Company, Glen-Brackly, Wis. Incorporators: D. H. Syme, C. J. Augustin and others. Capital stock, $5,000.

Brookfield Telephone Company, Ltd., Brookfield, N. Y. Incorporators: H. C. Brown, A. C. Miller, D. H. Foster. Capital stock, $1,000.

Minnesota Valley Farmers' Mutual Telephone Company, South Bend, Minn. Incorporators: D. D. Crane, G. A. Hultengren, T. D. Lewis.

Carlisle Co-operative Telephone Company, Carlisle, Ind. Incorporators: John Phipps, Salathiel Boon, Chas. Griffin. Capital stock, $10,000.

Northern Millbrook Telephone Company, Northern Millbrook, Ill. Capital stock, $600. Incorporators are composed of twenty farmers.

Beaufort Telephone Company, Beaufort, N. C. Capital stock, $100,000. Incorporators: N. W. Taylor, W. A. Moore, F. W. Clarke and others.

Rapids and Western Telephone Company, Rapids, Wis. Capital stock, $500. Incorporators: E. S. Bedell, J. E. Paulson and O. C. Stephenson.

Harris & Proctor Telephone Company, Junction, Ark. Capital, $2,500. Incorporators: D. F. Harris (president), C. A. Harris and J. D. Proctor.

East Watson and Gilmore Telephone Company, Effingham, Ill. President, George Kincaid; secretary, Mantz McCallen; treasurer, J. W. Phillips.

St. Louis and Eastern Telephone Company, East St. Louis, Ill. Incorporators: E. M. Evans, C. F. Wise, C. A. Combs. Capital stock, $10,000.

New Sharon Independent Telephone Company, New Sharon, Ia. William A. Bryan, president; W. E. Bryan, secretary. Capital stock, $24,000.

Nampa Automatic Telephone Company, Nampa, Idaho. Incorporators: J. S. Fox, A. K. Stoddard, H. C. Joyner. Capital stock, $20,000.

Belleville Telephone Company, Belleville, Dane Co., Wis. Capital stock, $5,000. Incorporators: Stanton E. Miller, Henry Ulerich and Orin Scott.

Mt. Olive Telephone and Electric Company, Mt. Olive, Ill. Incorporators: Gustave Schrier, W. J. Burns, G. A. Simpson. Capital stock, $5,000.

Reddick Independent Telephone Company, Reddick, Ill. Officers: F. R. Patchett, president; Fred Hansworth, secretary; S. G. McLane, treasurer.

Oklahoma Southern Telephone Company, Guthrie, O. T. Capital stock, $5,000. Incorporators: W. A. Jennings, Graham Burnham and R. E. Williard.

Home Telephone Company, Greenville, Tex. Capital stock, $100,000. Incorporators: R. T. Hicks, L. A. Chamberlain, E. D. D. Glandon and others.

McPherson Telephone Company, McPherson, Kan. Directors: J. G. Maxwell, H. I. Maxwell, J. E. Wright, John H. Wright. Capital stock, $40,000.

Platteville and Carnelia Telephone Company, Platteville, Wis. Capital stock, $1,300. Incorporators: J. L. Kliebenstein, B. F. Wily and J. W. Gill.

Homer Telephone Company, Homer, Iowa. Capital stock, $5,000. Officers: T. F. Collins, president; J. H. Brandt, secretary; W. J. Collins, treasurer.

Farmers' Mutual Accommodation Telephone Company, Eden, Ind. Capital stock, $85. Incorporators: S. D. Jackson, M. L. Frank and E. R. Walker.

Buffalo Telephone Company, Kearney, Neb. Incorporators: Geo. Bischel, Peter Wink, J. G. Reiter, John G. Lowenstein, W. J. Stadelman. Capital stock, $5,000.

Mutual Telephone Company of Trenton, Brookings, S. D. D. D. Safe, president; C. S. Ripley, secretary; H. H. Haggardt, treasurer. Capital stock, $5,000.

Amboy Telephone Company, Amboy, Indiana. Capital, $5,000. Incorporators: W. H. Miller, W. H. Houck, Robert Ridgeway, E. F. Cox and John Stancomb.

Rushville, Pleasant View and Browning Telephone Company, Rushville, Ill. Incorporators: M. W. Greer, M. S. Strong, S. R. Carey. Capital stock, $2,400.

Queechy and Flat Brook Telephone Company, Canaan Four Corners, New York. Capital, $500. Incorporators: O. F. Walker, Esek Finch and W. J. Lord.

Beaver Crossing Telephone Company, Beaver Crossing, Neb. Incorporators: Dr. C. W. Doty, J. H. Ritchie, Henry Gake and others. Capital stock, $5,000.

South Prairie Mutual Telephone Company, Muscatine, Iowa. Directors: J. P. Mountain, J. P. Nichols, W. J. Barclay, Adolph Vogel. Capital stock, $10,000.

Le Mars Telephone Company, Le Mars, Ia. Incorporators: J. W. Sammis, A. C. Colledge, F. A. Dalton, E. Duke Naven, M. H. Breen. Capital stock, $50,000.

Merchants' Telephone Company, Fontanet, Ind. Incorporators: H. J. Lambert, W. J. Randall, J. J. Kind, Edward King, all of Frankfort. Capital stock, $5,000.

Electric Light and Telephone Company, Wimbledon, N. D. D. R. Swarthout, president; Anton Tucker, vice president; J. L. Snare, treasurer. Capital stock, $50,000.

Farmers' Independent Telephone Company, Smithfield, Ohio. Incorporators: M. B. Cole, J. M. Copeland, A. H. Kreager, Frederick Scott. Capital stock, $10,000.

Old Turnpike Co-operative Telephone Company, East Chatham, New York. Capital stock, $300. Incorporators: J. P. Beaver, G. W. Schilling and Charles Young.

Connecticut Telephone and Electric Company, Meriden, Conn. Officers: E. C. Wilcox, president; B. L. Lawton, vice president and treasurer; B. C. Rogers, secretary.

Columbia Mutual Telephone Company, Columbia, Iowa. President, J. A. McCorkle; vice-president, W. A. Wilson; secretary, J. N. Shults; treasurer, W. Bingaman.

New Britain Co-operative Telephone Company, East Chatham, New York. Capital, $1,000. Incorporators: Samuel F. Phillips, D. V. Wadsworth and C. H. Carpenter.

Veedersburg Telephone Company, Veedersburg, Ind. Incorporators: John L. Osborn, J. K. Quinn, D. P. Heffner, J. M. Osborn, Chas. E. Osborn. Capital stock, $25,000.

Adena Exchange Telephone Company, Adena, Ohio. Incorporators: Jas. W. R. Smith, Wm. H. Thompson, Milton Hill, Geo. A. Ickes, John G. Ickes. Capital stock, $5,000.

Gowanda Telephone Company, Little Valley, N. Y. Directors: E. C. Fisher, J. N. Congdon, Wm. H. Britton, Jr., Wm. A. Dietrich, Wm. R. Smallwood. Capital stock, $25,000.

Pioneer Telephone Company, Guthrie, O. T. Directors: J. M. Noble of Oklahoma City, J. N. Coulter, C. J. Shepherd and B. S. McGuire of Pawnee. Capital stock, $50,000.

Capac Telephone and Messenger Company, Capac, Mich. Capital, $15,000. Incorporators: E. J. Buck, J. L. Willaughley, R. Morrison, W. H. Sturgis, C. E. Zilke, and others.

Orange Mutual Telephone Company, Orange, Ind. Capital stock, $3,500. Incorporators: W. F. Schroutz, W. P. Sipe, W. R. Conaway, George A. Looney and J. F. McKee.

Mercer Telephone Company, Princeton, W. Va. Incorporators: E. W. Maxwell of Spanishburg, G. L. Karnes, S. V. Straley, W. N. Mahood, J. C. Hughes and others of Princeton.

Weyers Cave Telephone Exchange, Staunton, Va. President, J. B. Kegay; vice president, S. A. Driver; secretary, N. L. Shreckhise; treasurer, S. C. Cline. Capital stock, $5,000.

York Eastern Telephone Company, York, Pa. Capital stock, $8,000. Directors: A. M. Grove, M. H. McCall, H. S. Merryman, John H. Wilson, B. F. Norris, Joseph A. Gailey and Calvin M. Shaw.

New York and Long Island Telephone Company, Albany, N. Y. Capital stock, $100,000. Directors: W. H. Bennett, G. L. Dennis, B. F. Talbot, I. M. Williams and Herbert Wright.

Pleasant Hill Telephone Company, Pleasant Hill, Ohio. Incorporators: A. J. Bermer, L. F. Grimes, Geo. H. Patrick, C. M. McLaughlin, E. E. Rothermel. Capital stock, $10,000.

Rural District Telephone Company, Buffalo, N. Y. Directors: W. F. Anderson, O. Z. Bonton, R. H. Brownell, F. H. Lincoln, F. C. Lincoln, W. T. Sampson, T. Granlin, P. R. Wright.

Dewey-Wareham Telephone Company, Junction City and Manhattan, Kan. Incorporators: C. P. Dewey of Chicago, H. P. Wareham of Manhattan, and others. Capital stock, $50,000.

Shady Grove Telephone Company, Shady Grove, Hancock County, Ind. Capital stock, $1,000. Directors: J. M. Burch, Joseph F. Shelby, W. H. Foster, W. W. Piles and W. M. Togue.

Filley Independent Telephone Company, Filley, Neb. P. M. Andersen, president; L. C. Andersen, vice president; R. Petersen, treasurer; Harry York, secretary. Capital stock, $2,000.

New Home Telephone Company, Bloomfield, Ind. Incorporators: John F. Slinkard of Bloomfield, Peter M. Stone and W. C. Bennett of Scotland and others. Capital stock, $50,000.

Citizens' Telephone Company, Tupper's Plains, Ohio. Incorporators: C. W. Okkes, L. L. Loman, F. G. Taylor, S. P. Dean, J. P. Parish, F. C. Chase, Geo. Shields. Capital stock, $10,000.

Thousand Islands Telephone Company, Clayton, N. Y. Directors: W. H. Consane, C. A. Ellis, G. H. McKinley, W. D. Clark, Chester W. Reeves, F. M. Hall, H. T. Dewey. Capital stock, $2,800.

Interstate Telegraph and Telephone Company, Austin, Minn. Capital stock, $60,000. Incorporators: James J. Keenan, Henry Birkett, Thomas A. Revard, Semour Johnson and Charles Sterling.

Brookfield Telephone Company, Ltd., Brookfield, N. Y. Incorporators: J. I. Keith and B. M. York of North Berlin, H. L. Spooner and A. D. Chesebro of Brookfield. Capital stock, $1,000.

Rowelsburg Improvement Company, Rowelsburg, W. Va. Incorporators: Geo. W. Hays, W. W. Schloch, M. H. Proudfoot, John T. Pierce, D. A. C. Porter, Carl C. Pierce. Capital stock, $25,000.

Maple Valley Telephone and Telegraph Company, Mapleton, Iowa. President, W. H. Leathers; vice president, J. C. Hammond; secretary, C. H. Smith; treasurer, T. B. Lutz. Capital stock, $100,000.

Santa Ana Home Telephone and Telegraph Company, Santa Ana, Cal. Incorporators: F. T. Graves, T. W. Watcher, C. L. Zahn, John Van Liew, Arthur Wright, all of Los Angeles. Capital stock, $100,000.

Eden Valley Exchange Company, Eden Valley, Minn. Incorporators: C. T. McDonald, M. E. Williams, W. L. Hutcheson, Matthew Werter, Wm. O'Brien, Geo. Tompers, L. E. Christ. Capital stock, $10,000.

Farmersburg, St. Olaf and Wagner Telephone Company, Farmersburg, Iowa. Incorporators: Henry Englehardt, Robert Scharf, Chas. Englehardt, Lars Thorson, Hebrian Knudson, Dan Reardon, Wm. Jones. Capital stock, $810.

Patriot and North Telephone Company, Patriot, Ind. Incorporators: Daniel Mead, E. E. Gregory, H. Warner, H. M. Douglas, H. Schroder, Arthur Douglas and James Strick of Patriot, and John D. North, Jr., of North. Capital stock, $5,000.

San Bernardino Home Telephone Company and Redlands Home Telephone Company, separate corporations. Directors: F. F. Graves, F. W. Wachter, C. L. Zahn, John Van Liew and Arthur Wright, all of Los Angeles. Capital stock, $100,000.

Citizens' Automatic Telephone Company, Denver, Colo. Incorporators: John C. Shields, F. F. Costelle, A. F. Dunnell, E. W. Geddings, A. G. Sharp, John A. Himebaugh, Frank G. Peck, C. L. Hennings, D. V. Donaldson, J. Arthur Connell, Irving W. Bonbright. Capital stock, $500,000.

Cooperstown, Cherry Valley and Sharon Springs Telephone Company, Cooperstown, New York. Directors: A. B. Cox, J. B. Cole, Cherry Valley; M. D. Eckler, F. C. Ward, Cooperstown; James Van Dusen, Howard Clark, W. C. Van Dusen, Kullar Clark, C. H. Butler and A. O. Marshall, Middlefield.

Have had TELEPHONY now for two years; could not and would not do without it. In fact, I do not see how any live telephone man once seeing it could ever get along without it. —R. R. GROGGETT, Spring Hill Mines, Nova Scotia, Canada.

You are giving us the best telephone journal published. I am a subscriber to several others, but always look with most eagerness for TELEPHONY, because there is so much "meat" in it, so to speak.—M. E. GUINTER, Gentry, Ark.

THE MANUFACTURE OF POCKET DRY BATTERIES IN GERMANY. *

Herr Zacharias, in a recent issue of the "Centralblatt für Accumulatoren und Elementenkunde," states that the manufacture of small dry cells for pocket use has reached large proportions in Germany, and that the necessities imposed by the manufacture of such small cells has caused new methods and materials to be used in this branch of the accumulator industry.

The smallest type of dry cell manufactured is 33 mm. in height and 15 mm. in diameter. A pocket battery of three such cells weighs only 125 grammes, or with lamp attachment 175 grammes. The lamps consume 0.25 to 0.30 ampere at 3.5 to 4.0 volts. As an example of the practical utility of these pocket batteries and lamps, the author instances their use by doctors for night visits in suburban or town districts, when numbers on gate posts or houses are practically invisible, and by military officers on night marches for study of maps, etc. The use of small lamps by dentists and surgeons for studying the interior of the mouth, etc., is also referred to.

In a subsequent issue of the same journal, Herr Zacharias discusses the manufacture of these small dry cells, and states that, owing to the smallness of the respective parts, the production of reliable cells is far more difficult than when dealing with cells of normal size and capacity. The carbon pencils in these pocket cells are only 6 mm. to 7 mm. in thickness, and the filling of depolarizing mixture around them is only 14 mm. to 16 mm. in diameter. The space separating the depolarizing mass and the zinc electrode is 1.5 mm. to 2.0 mm. in width. Owing to the smallness of the holder and of the zinc electrode, the cleaning and amalgamation of the latter is beset with special difficulties, and the insulation of carbon and zinc again requires special precautions. In order to insure perfect insulation it is now the custom to fix four small glass tubes around the depolarizing mass, and to cover the zinc bottom of the containing vessel with a small disk of sheet mica. The filling-in of the depolarizing mass around the carbon pencil cannot be carried out in the usual manner, owing to the small diameter and consequent fragility of the pencil. Many different methods have been employed for surmounting this difficulty.

One of these consists in the use of a mould with a center piece of steel representing the carbon pencil. The depolarizing mass is filled into this and beaten down with a suitably shaped punch, and the moulded block is then withdrawn and fitted into the cell. This method cannot be recommended, for the center opening must necessarily be left slightly larger than the carbon pencil, in order to admit it without the use of force, and electrical contact for the whole length of the pencil can only be obtained by compressing the whole mass with an outer wrapping of gauze and thread. The usual method of filling the space between the depolarizing mass and the zinc electrode with the semi-fluid material which is to act as electrolyte is inapplicable for the manufacture of these small cells, for the space to be filled only measures 1½ mm. to 2 mm. in breadth. It is necessary to pour in the electrolyte in a perfectly fluid condition, and to add then some element or compound which will thicken it or convert it into a jelly.

These special difficulties in the manufacture of small accumulator cells account for the fact that many of the cells of this type now on the market are unreliable, and on examination disclose important defects in their construction. Nevertheless, these difficulties can be surmounted, and certain firms are turning out reliable small cells by the thousand. It is customary to group three elements in a paper casing (provided at the upper end with three small tubes for escape of the gases) and to insulate the whole with a coating of resin.

The testing of these small batteries before leaving the factory is also attended with special difficulties. No method involving short-circuiting the battery can be employed without serious harm to the elements. The best method is to employ a voltmeter with a high resistance (up to 1,500 ohms) with readings down to 3 volts. Two readings of the terminal potentials of the small cell or battery are taken with this instrument—the first when the cell circuit is open, and the second when it is closed with a 10 ohm resistance coil. A cell in good condition, tested in this way, will yield readings of 1.5 and 1.4 volts, and from these one can calculate the internal resistance of the cell, which in this case is 0.71 ohms. Cells which have been badly put together in the factory, or have suffered partial discharge, will show a fall in EMF. under the above tests of from 0.15 to 0.30 volts. Messrs. Siemens and Halske have designed and placed on the market a useful testing set for dry cells and batteries. It consists of a small but accurate voltmeter, provided with an external 10 ohm resistance, which can be placed in circuit merely by pressing a knob. The zero point of the scale is in the center, and measurements up to 3 volts can be made with the current passing in either direction. By use of a series resistance of 30 volts, and a shunt of 1 ohm, it is possible to use this testing set for large cells or batteries.

As regards the efficiency of such small elements, Zacharias states that they compare well with the larger ones, and that in some respects they are superior to them. A small dry cell 55 mm. in height and 20 mm. in diameter sufficed to drive an electric clock for four weeks, or one-twentieth of the time limit of the dry cell usually employed for it, although its cubical capacity was less than one-twentieth of the larger cell.

Although the use of these small dry cells in this country has hitherto been chiefly in connection with the manufacture of electric toys and novelties, it is interesting to learn that in Germany their use is developing along more useful and satisfactory lines.

*From the "Electrician," London.

LAKE SHORE RAILROAD TO USE TELEPHONES.

Following the lead of the Illinois Central, Burlington, Alton and other western railroads, the management of the Lake Shore and Michigan Southern Railroad Company has practically decided to construct a private telephone system along its road to connect the division terminals. There will be 10 separate telephone stations between Chicago and Buffalo, and at the larger points, such as Chicago, Toledo, Cleveland and Buffalo, direct connection will be made with the company's private exchanges which serve the local offices in those cities. Two No. 8 copper wires will be used, they being strung on the telegraph poles now in use. The telephones will be used for general business that does not necessarily require a written record, and trains will be governed by telegraph, as at present. This plan, it is said, was first recommended by A. B. Newell when he was superintendent of the Chicago-Elkhart division four years ago, but it was never favorably acted upon until recently.

The Wisconsin legislative committee on state affairs has reported for passage a bill which provides that any telephone company operating in various cities of the state shall maintain similar rates in cities of similar size. This is a direct and forceful blow at monopoly methods.

The Tabor Telephone Company of Tabor, Iowa, has purchased the Malvern exchange. This gives the Tabor company control of fifteen exchanges in all, with a total of 1,200 telephones.